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AGRICULTURAL JOURNAL

ISSUED BY THE

DEPARTMENT OF AGRICULTURE, FIJI.

VOL. 8.]

DECEMBER, 1936.

[No. 2.

EDITORIAL.

THIS number of the *Journal* contains a record of the importation into Fiji of the giant toad which appears to find conditions congenial since it is breeding and spreading satisfactorily. Toads can now frequently be seen and heard in the evenings in the neighbourhood of the areas where colonies have been liberated and already reports have been received of their beneficial action.

The beneficial effects of lime in most tropical soils is generally admitted and the Government Chemist, in a concise article, clearly indicates the chief means by which lime ameliorates our soils in Fiji. He also mentions that the need for lime in Fiji soils was pointed out by the Department of Agriculture as early as 1916, and that recent experimental work showed definitely the beneficial action of lime in reducing the acidity of alluvial surface soils. The mechanical action of lime in soils is commonly recognised but the more important effect of lime in rendering plant nutrients in the soil the more available to crops might be better known. Fiji is fortunate in possessing an abundance of lime in the form of coral sand, the action of which may be accelerated by crushing it finely before application to garden soils.

An article on small copra driers is the most important feature in this number of the *Journal*. The Department of Agriculture is making a strenuous effort to improve the standard of Fiji copra, which, up to the present, has not enjoyed a good reputation and has in consequence commanded poor prices compared with some of the chief copra-producing countries. The type of kiln described in this number is simple in design, cheap in construction, free of fuel costs, easy to operate, independent of weather conditions and capable of turning out really first class copra and hence should prove a considerable boon to the Colony.

South Seas copra prices month by month from January, 1934, to September, 1936, have been priced in the world's market at an average of 14s. 2d. per ton less than Rabaul copra, at £1 3s. 8d. per ton less than Malayan copra and at £2 per ton less than Ceylon copra.

Thus South Seas copra is definitely inferior, chiefly because its manufacture is largely dependent on uncertain weather conditions.

This unsatisfactory situation is capable of being remedied and in fact must be remedied since it is possible that a time may come when bad copra will be unsaleable in competition with copra of better quality and with several other oils with which coconut oil is now interchangeable. The divergence in price between good and bad copra tends to be reduced when high copra prices prevail but general circumstances appear to indicate that, except when special circumstances arise, the average price of copra

over a long period is likely to be materially lower than it is at the present time (£14 per ton in Fiji). Hence the prospects are that there will be a material difference between the average prices realised for good and for bad copra over the next ten years, therefore no opportunity of improving the quality of the Fiji product should be missed.

Approximately 60 per cent. of the copra exported from Fiji is produced by small holders, mostly Fijians, therefore efforts in the first place are being mainly confined to this section of the producers who are annually responsible for the production of some 18,000 tons of copra. There is no reason why Fiji copra should not command prices at least equal to those paid for Rabaul copra, if not for Malayan copra, and if the average price of the small holders' product can be raised by 15s. per ton this would result in an increased circulation in the Colony of some £13,000 each year. This sum would be raised to over £20,000 per annum if similar improvement is extended to all estate-produced copra and this does not appear to be beyond the bounds of possibility if some form of grading can be adopted, so as to furnish the incentive provided by increased returns which would undoubtedly result if large consignments of good grade copra could be shipped.

Naturally, general improvement in grade is fraught with many difficulties but similar difficulties, economic and temperamental, have been overcome in other countries and the present apparent and welcome desire of the Fijians for improved economic conditions should assist in making gradual progress in the right direction.

Tobacco culture is being given increasing attention by the Department in the last 18 months and useful information on tobacco growing, harvesting and curing is contained in this issue. During his furlough, Mr. W. L. Parham took the opportunity of gaining much valuable information regarding the handling of this crop in Canada, and his notes and experiences will be very helpful in the development of this industry in Fiji. Mr. D. A. Donald has successfully carried out valuable experiments with harvesting, curing and fermenting of tobacco in the Colony and his results indicate that with certain modifications the Fijian "bure" can be admirably adapted for the satisfactory treatment of tobacco leaf suitable for cigar filler and wrapper purposes. It might be mentioned that varietal trials of some 30 types of tobacco are also in progress with a view to a decision as to the best two or three types suitable for local conditions and local purposes.

Efforts to resuscitate the cotton industry locally are in operation and though these efforts are strongly discounted by the more attractiveness of sugar cane and rice, certain small sections of the people appear to be definitely interested and in this *Journal* Mr. B. L. Field records some of the difficulties encountered in buying seed cotton and in ginning it. The recent adoption of single unit ginneries and the reduction of four grades for seed cotton to two grades in the last buying season have already shown that cultivators appreciate these changes.

Fiji has been most fortunate in the phenomenal success which has been achieved in the matter of control of insect, and even plant, pests by biological methods as evidenced by control of the Levuana pest of coconuts and of the weed commonly known as the "curse" (*Clidemia hirta*) and in this issue a belated article appears as a record of research dealing with the Leaf Miner pest of coconuts. In this article Mr. Taylor indicates the habits of this pest, the nature of its damage to the palms, its natural enemies, the cause of outbreaks, the selection of a suitable parasite to control the pest and finally the successful results achieved by the introduction of the larval parasite *Pleurotropis parvulus*, Ferr.

The modern means of detection of water added to milk are outlined in an interesting article by Mr. Blackie and it may be mentioned that the Hortvet Cryoscope has already proved itself a valuable weapon which will do much to prevent the pernicious practice of diluting milk used for domestic purposes.

It is not generally realised that this Colony carries some 12,000 horses. These require proper feeding and care if they are to give their best value to their owners and hence Mr. C. R. Turbet contributes a lucid account of the various necessary food constituents which should prove of utility and of interest. He stresses the need for a balanced nutritive ratio if full value is to be obtained from the various available foods, gives the best proportions to adopt in utilising the chief local feeds and mentions that "little and often" is wisely applied to the feeding of working horses.

A possible potential crop for Fiji is indicated in notes regarding arecanuts or betel nuts. These palms are easily grown, cost little in maintenance after the first few years and have a long cropping life. While the chewing of "betel" is not so common as in the Eastern tropics—possibly because the Indian can always afford to buy tobacco—still the indications are that more would be utilised if local supplies were available since over 20,000 lb of the prepared nut are imported annually into the Colony. Also, there is little doubt that a small export market could gradually be built up should a surplus of production become available.

Another potential crop for small holders in sheltered localities is the candlenut. This tree is found in isolated patches in general distribution through the Group and every effort is being made to find a market for the oil. Candlenut oil was formerly much in use but has latterly been replaced by tung and linseed oils, largely, it is thought, because supplies of the former were irregular.

Much experimental work has been done in connection with the adoption of suitable methods for the treatment of the crop and these experiments are lucidly compiled in this number by Mr. Blackie who draws interesting conclusions from the results up to date.

In addition to the articles mentioned several useful general, entomological and veterinary notes are found to complete this number of the *Journal*, which should be read with much interest.

THE GIANT TOAD (*Bufo marinus*).

By

H. W. JACK, M.B.E., B.A., D.Sc.,
Director of Agriculture.

THE Department of Agriculture first became interested in this amphibian early in 1933 when the Government Entomologist, Mr. Simmonds, who had made the acquaintance of the species in Trinidad, initiated inquiries into its feeding habits, hoping it might prove of value, as a general predator, in controlling slugs, beetles and millepedes, if introduced into Fiji.

Early replies suggested delay, pending further information. There has, for many years, been a strong feeling in entomological circles against the introduction of vertebrates into new countries, largely due to the unfortunate and ill-advised introduction made into the Australian Colonies by the early settlers.

In 1934 Hawaii became interested in the animal and it was introduced into that Group, where it very rapidly increased in numbers. From Hawaii a colony was taken to Queensland, where, it is understood, some were released. This action aroused severe criticism and further liberations were stopped.

Following the report of the introduction of the toad into Hawaii the question was asked in the Legislative Council (November 1935) "Will the Government give early consideration to the introduction of toads into Fiji, the introduction of which into Queensland and Hawaii has been so successful?"

To this the Government replied that "inquiries regarding the advisability of introducing the giant toad into Fiji for insect control were initiated in 1933, when the consensus of scientific opinion was that action should be postponed for a time. Further inquiries have since been made and should replies prove satisfactory the introduction of the toad will be undertaken."

Meanwhile records of stomach analyses had been coming to hand and these showed that beetles formed a considerable proportion of its food, and from Jamaica one record showed an average of 9.9 banana borers per toad. In view of these valuable records and the fact that no serious cases of the destruction of useful species were shown, in December 1935, the Department decided to make the introduction and hence 67 half-grown adults were imported from Hawaii through the courtesy of the Entomologists of the Hawaiian Sugar Planters' Association. These arrived in Fiji early in February, 1936.

In co-operation with the Colonial Sugar Refining Company, Limited, these were kindly taken over by Mr. Windred, Entomologist to that Company, who prepared a suitable breeding place at Lautoka. Breeding commenced at once and in April a colony was received in Suva. This colony was not a success having apparently been exposed to heat *en route* and were mostly dead on arrival. Further colonies received in May and June, however, arrived in splendid order and were released in Suva, Nasinu and Navuso. These are now frequently to be seen and heard in the evening.

Toads require still water in which to breed and will travel considerable distances to find it. It is important that they be allowed to concentrate in sufficient numbers to permit mating and the public are requested not to try to place them in their own gardens until their numbers have increased sufficiently to ensure permanent breeding.

Already reports of beneficial action by toads have been received from several sources and it is anticipated that they will prove a profitable addition to the fauna of Fiji.

LIME AS A SOIL AMELIORANT.

By

W. J. BLACKIE, M.Sc., F.N.Z.I.C., A.I.C.,
Government Chemist.

CERTAIN substances are added to soils, not in the capacity of fertilisers which supply essential plant foods, but for the purpose of improving production through their influence on the physical properties of the soil and thus the chemical and biological properties.

Among this class of substance we include calcium in the form of carbonate, lime, or slaked lime. Calcium is an essential plant food but most soils contain a sufficiency of this element for normal plant requirements and it is seldom that there is a necessity for its addition to supply plants directly.

Fiji soils vary much in their physical and chemical properties but there are a few characteristics that are common to most of them as being distinct from soils of European origin. In the first place they are remarkably deficient in carbonate of lime which is absent in the majority of cases and in the second place they are generally low in phosphoric oxide which in many cases has a negligible availability. This, no doubt, is due, in the case of lime, to the excessive leaching under humid tropical conditions and the low availability of phosphate is to be ascribed either to its fixation as aluminium and iron phosphate or its absorption by the colloidal complex of the soil.

The beneficial effects of lime can be considered under the following headings:—

- (1) Effect on tilth and bacterial action.
- (2) Liberation of plant food materials.
- (4) Effect on toxic substances and plant diseases.

(1) On clay soils lime has the effect of flocculating the dispersed particles which are then held together by the cementing action of calcium carbonate. By this means the crumb structure of the soil is improved and on heavy clays, tillage operations are assisted, drainage is facilitated and the soil is opened up to the atmosphere. In general, root development and bacterial action is facilitated by the improved soil conditions. With sandy soils calcium carbonate helps to bind the soil particles together making a somewhat firmer structure with a consequent increase in water holding capacity. Care, however, is necessary in regard to the application of lime to sandy soils since it has a tendency to increase the availability of potassium and probably phosphate which are the more readily lost from a sandy soil than from the clay type. A soil devoid of calcium carbonate is in a favourable condition for the development of acidity which may increase to such an extent as to be directly injurious to crops. There is also a greater tendency to lose nitrogen on light soils by excessive use of lime. When the neutralising effect of a base such as lime is used up, the more important bacterial actions concerned in the breaking down of organic matter and the conversion of its nitrogen into nitric acid is much hampered and it is probable that lime acts not only indirectly as a neutralising agent in these processes but also takes a definite chemical part in the reactions. The increased permeability to air induced by the flocculating effect also facilitates desirable bacteriological activity.

(2) Experimental work has indicated that there is a tendency for basic exchange to take place within a soil so that calcium may replace potassium and magnesium from the absorption complex. It is therefore readily

appreciated that by increasing the lime concentration on soils poor in available potash an increase in this important plant food may be occasioned and thus convert a soil deficient in available potash into a soil holding a sufficiency for the crop's need. Care, however, must be exercised in regard to sandy soils with low total potash. There is a good deal of evidence that under certain conditions, particularly with lateritic soils, phosphate may become locked up as iron or aluminium phosphate which is less soluble than tricalcic-phosphate in the soil solution. Or again it may be held tenaciously by the absorption complex of a soil. Evidence has been adduced to the effect that by supplying a base such as calcium a more soluble phosphate is formed and that liming a calcium carbonate deficient soil helps to render available some of this locked up phosphorous as well as preventing the locking up of applied phosphate fertiliser. Nevertheless experiments by D. Prianischnikov and Simmermacher and more recently by C. O. Williams in Natal tend to disprove this work although it must be admitted that there is considerable practical support for the theory. It is probable that both views contain a certain amount of truth and different results may be dependent on soil maturity or peculiar chemical conditions within a soil.

(3) It is well known that applications of calcium carbonate assist markedly in the promotion of the ammonification and nitrification processes that occur in soils. By an interesting series of processes organic matter is broken down in soils and a large portion of the nitrogen converted first to ammonia which is then oxidised to nitric acid. These processes are carried out by bacterial action which is retarded in the absence of a base like calcium carbonate which neutralises the nitric acid produced. The calcium nitrate formed is a suitable chemical compound for the supply to the plant of the essential plant food nitrogen. Any base would of course be satisfactory for this neutralising process but the addition of lime is the most economic method and is of great importance to crops which show a ready response to nitrate fertilisation. The absorptive properties of a soil for lime will determine the amount that should be applied. This can readily be determined in the laboratory by lime requirement methods or in the field by experimental trials. Kellerman and Robinson have indicated that for sandy loam soils a nitrate production was favoured by applications of lime up to 2 per cent. which is much in excess of normal requirements. Magnesium carbonate has a depressing action on nitrate formation and if this base is present in excess, that is above 0.25 per cent. the subsequent addition of lime would not ameliorate conditions.

(4) Free acidity in a soil has a marked effect in limiting production with most agricultural crops and promoting certain diseases such as "finger and toe" disease of the cruciferae and Panama disease of bananas. It is to be noted, however, that certain crops such as tea favour acid soils and calcium carbonate application is injurious to such crops. Also the continued application of calcium carbonate to potato soils promotes the development of potato scab. Fiji soils are on the acid side with hydrogen ion concentrations varying from 4.6 to 6.3 Ph. Soils of the sandy loam type at the Navuso Agricultural Station possess Ph values varying from 5.3 Ph to 5.77 Ph and a lime requirement by the Hutchinson method of 0.22 to 0.26 per cent., that is the parts of lime required to be added to 100 parts of soil to satisfy the lime demand. These figures indicated the necessity for the addition of about three tons per acre of calcium carbonate and since chemical methods usually indicate a lower value than the actual requirement, five tons of calcium carbonate in the form of coral sand was directed to be added to each acre of the area concerned. In another experiment 20 tons was added to a

small area. Controls were kept for each block and the hydrogen ion concentration of controls and limed blocks determined after a period of 18 months when the values quoted below indicate the value of lime in reducing acidity:—

Sample.	Treatment.	Ph.
Soil A	20 tons per acre	6.71
Soil A Control	No treatment	5.32
Subsoil A	20 tons per acre	6.71
Subsoil A Control	No treatment	5.28
Soil B	5 tons per acre	6.53
Soil B Control	No treatment	5.36
Subsoil B	5 tons per acre	5.77
Subsoil B Control	„	5.77

These figures also indicate as far as acidity of the surface soil is concerned that applications of calcium in the form of coral sand at the rate of five tons per acre is effective on the sandy loams of the Navuso Agricultural Station. The hydrogen ion concentration was determined by the electrometric technique using the quinhydrone electrode.

Similar results were obtained by C. O. Williams with soils in Natal. Applications of calcium carbonate at the rate of 1,500 lb ground limestone or calcite applied annually over a period of ten years showed Ph values of 5.9 on limed plots and 5.6 on the unlimed plots. In these experiments, however, results were influenced somewhat by artificial fertiliser and other treatment.

Lime may be applied to the soil either as burnt lime (Calcium oxide) slaked lime (Calcium hydroxide) air slaked lime (Calcium carbonate) ground limestone or calcite (Calcium carbonate) or as in Fiji, coral sand, which is also Calcium carbonate.

Quick lime or burnt lime and water slaked lime have a distinctly alkaline reaction and act rapidly in removing sourness. They are, however, soon converted either into insoluble forms or into the carbonate. The presence of a small amount of Calcium carbonate is a necessity in most soils and this component should not be allowed to fall below 0.5 per cent. Quick lime is useful in having a greater granulation effect on a soil and is therefore of value on heavy clay soils. It however has an adverse effect in assisting the loss of nitrogen from a soil and in using this variety for opening up clay soils it is better to incorporate frequent light doses.

Calcium carbonate in the form of air slaked lime has the advantage of being in a finely divided state and does not possess the adverse effect of burnt lime on organic matter. Its granulation effect on heavy clays is not so pronounced as burnt lime but crumb structure is improved over a period. Calcium carbonate in the form of ground limestone, ground calcite or coral sand should be finely ground to pass a sieve of at least 50 meshes to the inch. These forms of carbonate also are often impure and for agricultural purposes should contain 80 per cent. of calcium carbonate. Coral sand used in Fiji varies from about 80 to 94 per cent. calcium carbonate.

It might be mentioned that it was pointed out by Wright in *Bulletin* No. 9, 1916, Dept. of Agriculture, Fiji; and also in *Bulletin* No. 11, 1919, that Fiji soils were lacking in calcium carbonate. It is also worthy of note in 1921 the Colonial Sugar Refining Company adopted liming with coral sand as a fundamental soil treatment with highly beneficial results.

SMALL COPRA DRIERS.

By

G. F. FLEMONS, Assistant to Government Chemist.
L. W. HARWOOD, H.D.A., Agricultural Officer, East.

TOWARDS the end of 1935, the Director of Agriculture, with a view to stimulating the artificial drying of copra among Fijian small holders, introduced the type of small copra drier which had already proved to be effective in Malaya. Climatic and economic differences, however, necessitated its modification for operation under Fijian conditions and the writers were instructed to carry out experiments designed to effect the improvements to suit local conditions.

From the climatic point of view it was found that owing to the constancy of the wind, especially in the copra producing districts, that the exposed drier was not suitable. For this reason the unit has been erected in a well constructed "bure" (native thatch house) having only one door and no windows thus insulating the actual kiln from the outside air. The effectiveness of this "bure" is well evidenced by the reduction in fuel consumption and the equalisation of temperatures in the copra chamber.

From the economic side it was appreciated that units having a large capacity would prove to be too arduous and expensive for the average small holder in this country. A compromise has, therefore, been effected and a drier, having a capacity of approximately 1,500 nuts, capable of producing a quarter of a ton of copra per drying has been standardised.

The essential features of this kiln are that its cost of construction is low; it is easy to erect; fuel costs are negligible; its thermal efficiency in relation to its cost and the supply of shell fuel is satisfactory and drying routine is simple and effective in assuring a good grade of copra.

The kiln is composed of two parts, the copra chamber and the combustion chamber, the latter incorporating the fire pit. The top (copra) chamber is separated from the bottom one by wire netting supported on iron bars or rods to give it sufficient rigidity and is of the dimensions 6ft. by 6ft. by 2½ft. giving a capacity of 90 cubic feet. The depth of a charge consisting of 1,500—1,600 nuts, each split in half, is from 15in. to 18in. and the weight of the product, dried to a moisture content of 5—6 per cent. is approximately a quarter of a ton.

The combustion chamber is constructed with sloping sides as suggested by the Director of Agriculture. This improvement assists the rising hot air current since it is concentrated from a basal section of 8 by 8 feet to a top section of 6 by 6 feet. The baffle plate which ensures the even distribution of the heat is 6 by 6 feet, and is suspended horizontally one foot below the wire netting (half inch mesh) which forms the copra platform. The baffle plate has holes ¾in. to 1in. punched at intervals of four inches over its entire area, through which the rising heat is distributed uniformly. The hot air rising through the copra becomes charged with moisture and is dissipated through the roof of the "bure," aided by a little ventilation embodied in the structure of the "bure."

The principle of the drier is elementary but effective. Clean and dry half shells, obtained from the preceding dryings, are cupped one into the other and placed in a "worm" around the sides of the fire pit. These constitute the heating element. As can be seen from the plan, bottom ventilation pipes (bamboo or iron) are fitted and the warm air of the 'bure' is drawn down these tubes to the bottom of the fire pit and thus quickly becomes heated. Moderate precautions (caulking) are taken to prevent the entrance of air at the other points of the combustion chamber.

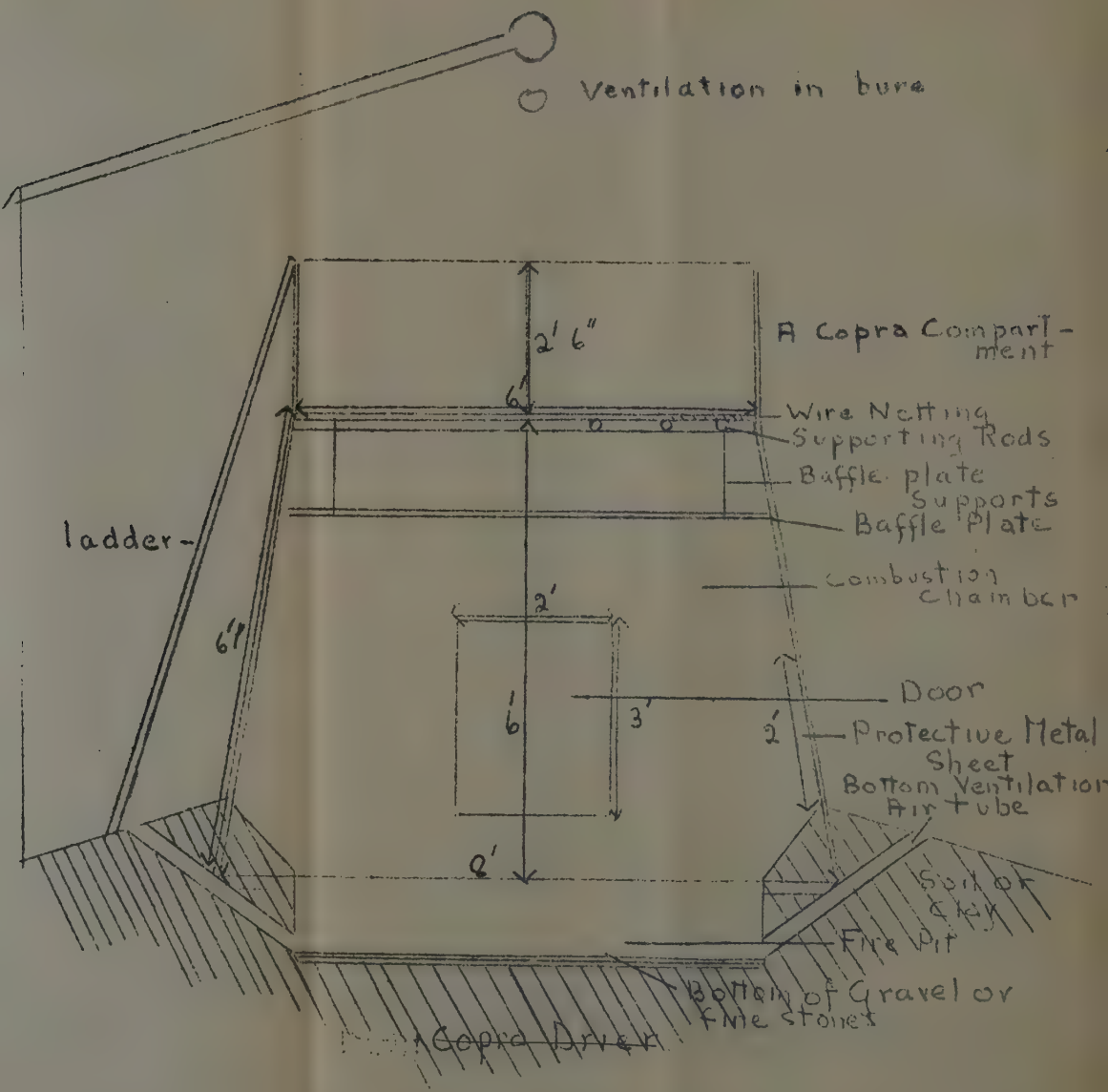


Diagram I.

From the above considerations it is evident that the "bure," plays a large part in the efficiency of the kiln. The "bure" should be erected in a carefully selected and well-drained location, bearing in mind the fact that the base of the fire pit is one foot below the surface of the ground and that any possible entrance of moisture through percolation would seriously affect the drying of the copra. Surrounding the "bure" a drain should be dug such that, at all times, the water level in it should be at least twelve inches below the level of the floor of the fire pit.

Provided that the materials used in construction are poor conductors of heat and that the principles of construction are observed, any readily available materials may be utilised. Kilns have been satisfactorily constructed of rough sawn timber and of "bush" timber with equally good results and as "bush" timber is always easily available this type of kiln is recommended especially as its use reduces the cost of construction to less than 25s. exclusive of the costs of labour employed in erection of the kiln and the "bure."

For a "bush" timber kiln the only materials which normally require to be purchased are:—

Nails (2 lb 4in, 7 lb 3in., 3 lb 2in.)	..	..	..	£0	4	0
Hinges for door (1 pr. 6in.)	..	..	..	0	1	0
Wire netting $\frac{1}{2}$ in. mesh (6ft. by 6ft.)	..	..	..	0	3	0
Supporting rods (4 pieces angle iron 6ft. 4in.)	..	..	..	0	5	0
Baffle plate (2 sheets 6ft. by 3ft. wired together)	..	..	..	0	10	0

£1 3 0

Of the above items the hinges can be dispensed with, and iron supporting rods can be substituted by old water piping or other iron bars or by bush timber polings, but iron is preferable. Protective tin sheets around the inside wall of the kiln can always be made of flattened biscuit boxes or kerosene tins, &c. "Niusawa" has been found to be very suitable for the walls of the kiln and any hard timber may be used for corner posts.

Should sawn timber be utilised for the kiln construction, approximately 350 super feet would be required. If imported rough oregon is used, this will cost about £4 10s. 0d. but if local "Kauvula" or similar timber is used the cost should not exceed £3 10s. 0d. and timber is best purchased in the following dimensions, if possible:—

Corner posts	..	..	..	4 pieces (4in. by 2in.)—length 6ft. 2in.	
Bottom stays	..	..	..	4	8ft.
Top stays	..	..	..	4	6ft.
Door supports	..	..	..	2	6ft.
Copra chamber stays	..	..	..	2	5ft.
Planks—combustion chamber	..	12	(12in. by 1in.) length		15ft.
Planks—copra chamber	..	4	(12in.) length		6ft.
Planks—copra chamber	..	2	(6in.) length		6ft.

Diagrammatic plans (diagram 1) of these small kilns can be had on application to the Department of Agriculture. In addition, when requested, materials will be supplied to small holders at cost price and every assistance will be given in the construction and routine operation of the kilns by trained Native Field Assistants.

The drying procedure is as follows:—

First day.—Husk 1,500—1,600 ripe nuts—one man can do this in 10–11 hours.

Second day (6 a.m.)—Split the nuts, discard bad ones or those with a germination core of more than $1\frac{1}{2}$ inches in diameter. Drain the half nuts half an hour, meat side downwards on a clean porous surface ("vata").

(7 a.m.).—If dull or wet weather prevails, light at both ends, a single row shell fire of 160 half shells disposed as in diagram 2.

(8 a.m.).—Place the drained half nuts on the kiln and maintain the above fire continuously till early next morning by building a new "worm" of shells as the previous one burns out. First day requires about 350 half shells and the half nuts in the copra chamber should be turned about 2 p.m.

Third day (6 a.m.).—Turn over the half nuts in the copra chamber. Set and light a double row shell fire (see diagram 2) and maintain for 20 hours—this requires about 650 half shells. About noon the nuts in the copra chamber should be turned over.

Fourth day (6 a.m.).—Turn over the half nuts in the copra chamber, set and light at one end a single row shell fire and maintain it continuously until evening. This requires about 300 half shells. Turn over the nuts in the copra chamber about noon. In the evening or early next morning separate the copra from the shells and remove both from the copra chamber.

Should the morning of the second day (first day's drying) be hot and sunny, the drained half nuts should be turned so that the meat is exposed to sun and wind as long as the sun remains hot. By this means, smoke damage is reduced to a minimum since the surface of the meat is partially dried before the half nuts are transferred to the kiln by 5 p.m., not later, (sooner if sunny weather fails). Again, in this case, the fire in the kiln should be started an hour before the half nuts are placed in the copra chamber when the above programme of drying is continued in the kiln as from the same hour on the first drying day.

After the completion of drying, the copra should be piled loosely on a dry surface in part of the drying "bure" and turned over daily for several days before bagging.

Should a thermometer be available, the drying process can be regulated by adjusting the fires to maintain temperatures (in the middle of the copra) within the following ranges:—

First day's drying 45°—55°C.

Second day's drying 55°—65°C.

Third day's drying 45°—55°C.

Overheating on the first day is liable to caseharden the copra, resulting in irregular drying, while underheating on the first day renders the copra liable to become mouldy. Cold spots in the kiln and inequalities in heating result in bacterial sliming giving a reddish brown product. This is best avoided by turning over the copra at least twice daily as indicated in the routine procedure.

After the second day's heating, much of the copra should fall out of the half shells and such self emptied half shells should be removed in turning over the copra before starting the third day's firing. The third day's firing should be continued until the copra is properly dry when it will break under pressure with a sharp snap and the fracture will reveal an even pearly surface. Should this not occur after the third drying day (due to wet weather) the single row shell fire must be continued into the fourth day. In filling the copra into sacks, it should be heavily rammed down with a heavy (and dry) beam of timber to ensure not more than 15 bags to the ton weight of copra (it can be reduced below this number).

Some twenty of these kilns have already been erected by Fijians who are realising that they can themselves produce good copra in place of selling their wet or partially dried meat to Chinese storekeepers at depressed prices. In addition, there are inquiries and requests from all copra producing areas for Native Field Assistants to go and supervise the erection of many more kilns so that it is fairly safe to state that this type of kiln has come to stay and that it will prove a big factor in effecting an improvement in the quality of Fiji copra.

Arrangement
of half shells
for 1st day's
firing

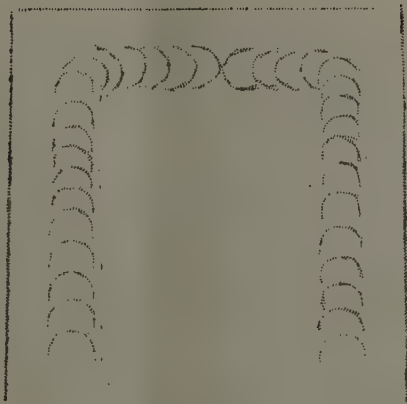


Diagram II.

Arrangement
of half shells
for 2nd day's
firing

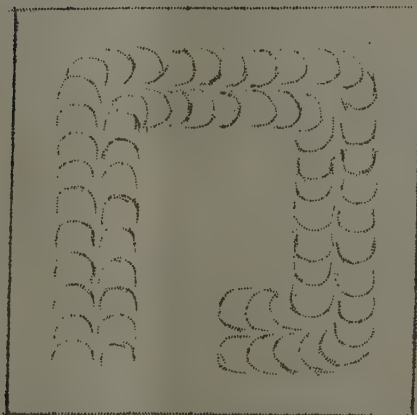


Diagram III.

and that it will prove a big factor in effecting an improvement in the quality of Fiji copra.

TOBACCO NOTES.

By

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Agricultural Officer, North.

THIS article is intended to portray the present state of the tobacco crop in the light of observations made and information gained during a recent visit to Canada where every courtesy was shown to the writer.

The Canada tobacco growing industry has been long established, the first French settlers having learned the art from the Indians and the present importance of the crop is indicated by the estimated production for 1935 of fifty-five million pounds and by the maintenance of a special Dominion Tobacco Service conducting experimental and extensional work.

In Fiji the contrast is great. The crop is in the hands of Indians and Fijians who are so much out of touch with their markets that prices fluctuate violently from as low as 3d. per lb to as high as 6s. per lb. The Fijians still show evidence of the value of instruction received when tobacco was a "tax" crop, and some Indians possess a good practical knowledge, but the crop has been too long at the mercy of individual whim and ignorance.

Tobacco is one of the most sensitive reactors to all the varied factors that affect plant growth. For instance the "burn" alone is influenced by at least five variable factors; locality, climate, soil, season and cultural methods, while varietal differences play a very important part. In Quebec, it is stated that twenty-nine varieties are commonly grown and comprise six types according to method of curing and utilisation. Subsequent to growth, the leaf has yet to be subjected to the important processes of curing, fermentation and storing and want of uniformity in any one of these may involve an equal want of uniformity in the product.

In fact, it is not often sufficiently realised how numerous are the qualities demanded in a good tobacco.

Typical of the "points taken into consideration" are those mentioned in *Tobacco Station Bulletin* 10—New Haven, Connecticut, which states that "in judging the burn," the following points are taken into consideration:—

- | | |
|---------------------------|----------------------|
| 1. Fire holding capacity. | 5. Flavour. |
| 2. Colour of ash. | 6. Aroma. |
| 3. Closeness of burn. | 7. Coherence of Ash. |
| 4. Evenness of burn. | |

These points have particular reference to cigar tobacco, but they are typical of the variety and exacting nature of the requirements for a good quality product, and indicate the difficulties to be faced.

It is obvious that the selection of a variety of Tobacco and of a suitable locality is but the commencement of a series of problems to be solved before any specific type of tobacco can be produced.

In Fiji, certain localities have become known as producing superior quality tobacco, and a few more or less fixed varieties have been evolved save where European enterprise has caused the importation of new varieties with subsequent crossing.

In Quebec, the large range of varieties grown and marketed by name is a serious problem, and the Dominion Tobacco Service now distributes free seed of desirable pure varieties in an endeavour to obtain the uniformity that is so essential to modern market requirements.

Fiji has still the advantage of a paucity of varieties in general cultivation and it is undesirable that this number be added to needlessly. The decision rests with the consumer, and at present the local consumer is content with the local product.

The section that demands imported tobacco requires a product which is probably beyond the ability of either Fijians or Indians to supply at present since the curing of such tobacco is so much an art that on the American Continent experts are paid to undertake this special task after harvest.

Therefore in Fiji, for some years yet, the aim should be to discourage the introduction of new varieties save for definite and controlled experiments such as are already in progress by the Department of Agriculture. It is possible however, that the long acclimatised and locally appreciated native tobacco may provide a type suitable for our needs and with this end in view seed of the main local type has been sent to the Central Experimental Farm, Ottawa, for trial and the opinion of the Canadian tobacco experts will be of interest. In addition, selection experiments are envisaged locally.

Reference has been made already to the attention paid in Canada to the purity of tobacco seed and this important consideration is altogether neglected by native growers in Fiji. In *Bulletin* 38 published by the Canada Dominion Tobacco Service it is authoritatively stated that "plump, heavy seed for the production of strong vigorous seedlings is really more important than in producing practically any other crop." Also it is practically impossible, in selecting plants at the bed, to discard all of the weak seedlings produced from small light seed, therefore selection should be effected by cleaning the seed before it is sown. Furthermore, the average germination percentage of ordinary seed is about fifty while well cleaned seed should give a germination percentage of about ninety; hence with cleaned seed a smaller bulk of seed is handled at the time of sowing, and as a rule, a uniform stand is more likely to result. The cleaning of tobacco seed in Canada is done with a very simple but efficient apparatus in which the seed is subjected to a blast of air sufficient to drive off trash and light seed.

There is much room for improvement in Fiji in the sowing of tobacco. A handful of dirty seed is thrown on a roughly prepared bed—often the former site of a "bure" that has been burnt down. The selection of a site sterilised by fire is sensible, and a sign that the growers should be reasonably receptive to teaching. Even allowing for the necessities of a vigorous climate the precautions taken in Canada to obtain robust seedlings are very thorough. One of the simplest of these precautions would effect a vast improvement in Fiji and this is the avoidance of over crowding in the nursery which is effected by the mixing of the seed with a suitable medium such as cornflour in the proportion of one of tobacco to fifty of cornflour. The mixture, sprinkled from a common salt shaker, provides an even distribution of seed as the flour is so conspicuous. In Fiji, the more readily available medium is wood ash. In mixing, the seed is best sprinkled on successive layers of ash, the whole then being mixed uniformly.

In general cultural practices, experience has taught the Fijian growers adequately so that contrasts are not obvious.

In harvesting however, the distinction between scientifically guided practice is again evident as well as the blind groping of primitive agriculturists. In Canada the enlightened grower is advised by experts who have evolved a precise practice for the production of leaf to suit the requirements of manufacturers. For instance, every step in the handling of leaf from harvesting to sale is planned and specially designed equipment is utilised. In experimental Stations the routine harvesting, curing, grading, fermenting,

and packing are studied critically resulting in improvements in detail. Thus, for whole plant harvesting knives or hatchets for cutting the stems are now replaced by long two-handed shears with which the harvesters work quickly, leaving the plants in neat rows with the butts all facing towards the sun. Another simple but beneficial improvement is the introduction of grading boxes into which the leaf is placed directly on stripping from the fermenting stack and in which baling is possible by a simple press.

Simplicity is studied so that much equipment may be made inexpensively on the farm.

The writer made a particular study of all methods employed in Canada, though it is premature to hope for such efficiency with the ordinary type of grower in Fiji. Unlike Canada where expert tobacco buyers can trace a defect back to some primary error, Fiji has for its tobacco market customers, who cannot define their requirements so that the experimentalist in this country is faced with the comprehensive task of first defining the desirable characteristics, and then of seeking them.

Amongst local advantages the thatched "bure" can be a most desirable curing shed and is superior to the average shed utilised by the inferior type of agriculturist in Canada, while the uniformity of an insular climate counteracts to a material extent, the lack of scientifically designed curing barns and the absence of specialists in the delicate art of curing and fermenting, so that at his best, the local tobacco grower can turn out a fairly good article.

Provided with reliable seed, and a steady market for a specified type of leaf the Fijians and Indians should find it possible and profitable to produce local tobacco of reasonably good quality.

The Department of Agriculture is already assisting with seed towards attaining this desirable objective, and is now undertaking to purchase dark leaf of good quality and from 15 inches to 18 inches in length in order to afford a steady market for growers who can also retail larger leaf at the more advantageous prices often obtaining, and utilise rejected leaf in making "uma" twist.

It is hoped that advantage will be taken of the assistance offered and that the local tobacco planting industry will expand considerably.

The numerous publications of the Dominion Tobacco Services, Canada have been freely used in compiling these notes and full use has been made of very instructive discussions with officers of that Service and with the staffs of the Imperial Tobacco Company and of Benson and Hedges (Canada), Ltd., Montreal.

The writer is highly appreciative of the consideration shown him during his brief visit to Canada.

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COTTON BUYING AND GINNING.

By

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In the buying and ginning of cotton there are many snags which have to be encountered and which can only be recognised by experience and by careful inspection at all stages of the work.

Fortunately in Fiji the buying and ginning of cotton is beset with few snags compared with many other cotton producing countries.

The reason for this satisfactory state of affairs is that the growers and sellers of the present day are not new hands at the business, and have had a strict training since the revival of the industry in 1923. The varieties now grown are two only—Sea Island and Back Cross 172—both being classed as extra-long-staple cottons. The other varieties found growing when the industry was revived in 1923 and the new varieties introduced surreptitiously in 1923–24–25 were all cleaned up on Viti Levu by the end of 1925. So that the greatest snag or snare, that of mixing of various cotton is almost out of the question in Fiji. Nevertheless, a constant vigilance is still necessary since a small portion of mixed lint may be drawn from a bale when sampling and this may wreck a good reputation not only as regards all the bales in a particular shipment which will be treated with suspicion and a corresponding cut in price, but all future shipments will have to live down a doubtful reputation as well.

LOSS IN LINT.

Though every care may have been taken to test the lint yield or percentage early in the season, and though allowances may be made for the seasonal conditions, it is usually found that there is a distinct falling off in the percentage of lint. This in Fiji is invariably due to the weather, as damp or imperfectly dried out seed cotton or fraudulently watered material may become defective in lint percentage. One cannot be too careful over this snag and allowances have to be made to cover it. Damp seed cotton results not only in loss of weight, but in class, strength and ginning output, as well as producing poor seed. There is also the risk of spontaneous combustion. When "passing" the least suspicion of internal dampness should be checked critically by emptying the bag and if found intentional, the culprit should be heavily discounted in assessing the weight.

DYE FROM BAG MARKS.

Some sellers and growers mark their bags with "Aniline" dyes, crystals or powders, which have not been properly mixed, the result being that some of the dye stuff penetrates or works through the bag, and on to the seed cotton. This is serious, as the powders or small crystals cannot be detected at the time of passing or ginning and the defects may not show up until the yarn is being conditioned, or the fabric dyed. If there is the slightest doubt of the dye entering the seed cotton, then immediately the marks should be cut out of the bag, and a few handfuls of the seed cotton removed and thrown right away from all other seed cotton and the bag should likewise be destroyed. Ordinary washing blue is the best marking substance in Fiji. Anatto may be used, also properly mixed paints. Oils should not be used for making up marking paint as it is frequently found not mixed properly and large patches of damaged seed cotton are found in bags, due to the absorption of oil. The use of dyes and paints for marking bags should always be discouraged.

FALSE PACKING.

This is not a common practice in Fiji. Those who were caught at it in early days were severely dealt with and it ceased after 1925. Occasionally stones with seed cotton at 2½d. and 3d. per pound, are still to be found, however, but the worst form of adulteration is the use of fine sand. Nowadays false packing is seldom seen but still it is necessary to have every bag emptied, turned inside out and picked clean of all adhering seed cotton. Bags that open up with a nice surface that has been fluffed out are always suspicious. To improve the appearance sellers may fluff, or open out the top layer of seed cotton. This naturally improves the class or appearance but should be carefully examined before being passed. Now that all seed cotton is being purchased as F.A.Q. standard and a lower grade, strict grading and classing is of less importance, but it is still necessary to examine every bag of seed cotton delivered since once a trick is found to be passable it will undoubtedly be repeated.

" PIG-TAIL " COTTON.

Though this type of seed cotton is clean and free from all trash it is troublesome as in the process of the extra cleaning the fibres become twisted and 10 per cent. to 15 per cent. may have to be removed. This extra cleaning process is quite unnecessary and most of the growers know it. Also it prevents the lint from being ginned properly and reduces the ginning output. Hence this type of seed cotton should be discouraged firmly.

DESPATCHING SAMPLES AND BOXING STANDARD TYPES.

To save loss in business, time and confusion samples should never be despatched without enclosing two separate labels, giving the description and marks. It is also advisable to inscribe such marks both on the outside and inside of the wrapping paper, or boxes.

TIPS ON GINNING.

The ginning of cotton in Fiji is done with the simplest type of roller gin—the Macarthy Single Action, Single Roller Gin. This gin stands out on its own when ginning long stapled cotton, such as the Sea Island. The object in ginning is to remove the lint or hair from the seeds, with as little damage as possible, also to extract all dirt and foreign matter. Sea Island or extra long stapled cotton cannot be treated in Saw Gins, or passed through " openers " " extractors " or various kinds of cleaning machines as can short stapled cotton. The process of cleaning is by picking it by hand and whipping or throwing it against a wire netting frame, which opens or fluffs out the hairs on the seeds and removes foreign matter prior to ginning. Opening the seed cotton improves the outturn from the gin, but the " opened " fluff should not be rammed into the hoppers of the machine.

OILING GINS.

In oiling, care should be taken that the gin boy is not too liberal with the oil, especially at loose pulleys, and end bearings. Oil guards should be properly fixed, otherwise there is the risk of the lint being splashed with oil. Only heavy oil, such as axle grease should be used. The end bearings of the roller accumulate cotton, which has to be removed now and then. This cotton must be put into a different bag and not thrown on to the cleaning cots. It should not be shipped out of the country, but used locally for stuffing cushions, &c.

LOSS IN OUTTURN.

The loss in outturn varies with the class of seed cotton being ginned. The most frequent cause of poor outturn is due to sleepy labour, roller belt slipping, or to smooth rollers. The roller should be roughed at least twice a week, with a carpenter's crosscut hand saw without set. If set, and in unskilled hands, it rips the grooves in the rollers, thus causing the cotton to "nep" and also forms ragged spots, which on further roughings, become larger and eventually cause cut seeds or squeezed seeds to pass under the fixed knife. The effects of "forcing" the gin or speeding it up excessively may improve the outturn, but damages the lint, causes nep crimping, weakens the hairs, removes the sheen or bloom and straightens out the convolutions and in some cases changes the colour. The roller should never get so hot that it cannot be touched by the hand. Gin feeders have a habit of pushing the seed cotton on to the grid mouth with the palms of their hands. This rolls or creates a kind of "pig-tail" cotton, which knots and is liable to be cut in ginning. The feeding should be done by shaking the cotton, to open it and then by sprinkling or throwing it evenly along the grid. Overpacked grid spaces lead to roping or rolling of the seed cotton which damages the lint, and at the same time lowers the outturn. An experienced gin feeder will get 15 to 20 per cent. better return. Good dry seed cotton gives the best outturn, which improves with the increase of atmospheric humidity but the seed cotton must not be damped in Fiji.

BROKEN FIXED AND MOVING KNIVES.

These are usually caused when ginning Sea Island, by back lashing cotton, or cotton clinging on to the roller instead of freeing itself at the "fall" with the result that it passes back under the fixed knife which is forced out and comes in contact with the moving knife. Wet seed cotton and lint should never be fed to the gin. It will break the knives.

The idiosyncrasies of ginning and gin setting are numerous. Makers' rules, gauges, &c., are of little use. Each cotton seems to have different needs, and it is only through practical experience, and experimentation that correct results are obtained. It is necessary to be on the spot, and in direct contact with it when the snags that drift along the path of the grader or ginner can be more easily explained. The personal element plays a large part both in the grading and in the ginning of cotton, in spite of all the recent scientific investigations. However, it is pleasing to note that much more attention is now being paid to the ginning of cotton, which has been sadly neglected, and it has been a mystery to many why the damage and waste in the cotton was never tackled from the commencement of its mechanical treatments.

THE BIOLOGICAL CONTROL OF THE COCONUT LEAF-MINER
(*Promecotheca reichei*, Baly) IN FIJI.

By

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Late Entomologist, Coconut Committee, Fiji.

INTRODUCTION.

Promecotheca reichei is an indigenous insect in Fiji, and there can be little doubt that until about 50 years ago it was well controlled by indigenous natural enemies. The advent and development of trade, however, and the extensive cultivation of the coconut palm, resulted, indirectly, in this insect becoming a serious pest, particularly in the Lau Group. A very detailed study of the insect itself, and of its natural enemies in Fiji, was made in 1929; and this study served to reveal the factor which had been responsible for making a pest of this previously well controlled insect, and suggested, at the same time, that an economically satisfactory equilibrium might be restored by the introduction of a suitable parasite from overseas. No suitable parasite was known at this time, but a preliminary investigation in Java in 1930, made by R. W. Paine, led to the discovery of a large number of parasites of an allied species of *Promecotheca* (*P. nuciferae*, Maulik), which occurs throughout Java, but is never a pest. Paine was unable to study these parasites in detail, being then primarily engaged in other work, but in 1932 they were thoroughly investigated and the opinion was formed that although most of them were incapable of satisfying the exacting conditions in Fiji, one of them was theoretically capable of doing so. This one was introduced into Fiji early in 1933, and within a year it had completely suppressed all the severe outbreaks of *P. reichei* which were then raging.

The writer hopes to publish a detailed technical account of this campaign at a later date, and the present paper is intended only as a general statement for those who are not interested in full entomological details and statistics.

P. reichei—ITS HABITS AND THE NATURE OF THE DAMAGE DUE TO IT.

P. reichei is a day-flying beetle which lays its eggs upon the undersides of coconut leaflets. The eggs are laid singly, and each is covered with a capsule composed of semidigested particles of coconut leaf-tissue which are expelled as excrement by the female immediately after the act of oviposition. The larva lives wholly within the leaflet, forming an elongate mine which, when completed, is usually about 6 inches long and 0.4 inches wide. When fully grown the larva becomes a pupa within the mine, and in due course the adult beetle emerges from the pupa and from the mine, biting a characteristic hole, oval in outline, in the upper wall of the mine to effect its escape. The adult beetle feeds upon the leaves externally, making linear incisions in the lower epidermis and the parenchymatous tissue, without, however, penetrating the upper epidermis. The total life cycle, from oviposition to emergence from the mine, covers approximately three months, and a further period of two weeks elapses before oviposition commences. Each female then continues to oviposit for 2 weeks, laying about 20 eggs in all. The small egg-capacity is particularly noteworthy.

In severe outbreaks the activities of the larvæ and adults together caused a reduction of about 75 per cent. in the functioning leaf surface of every

tree over wide areas. The population of this insect in any one tree was usually about 4,000 at the time when an outbreak was at its height, and no extensive spreading took place until this density of population was attained.

THE NATURE OF OUTBREAKS.

Outbreaks developed very slowly on account of the long life cycle and the small egg-capacity of the insect. The pest was found to require 14 months to multiply from a condition of rarity to one of maximum abundance within the area initially occupied by it. To a casual observer the outbreaks appeared to develop very suddenly, but this, in fact, was never the case.

Almost all outbreaks of maximum severity displayed one remarkable feature; namely, that only one stage of the pest was present at any one time. That is to say, there was no extensive overlapping of generations. In a climate like that of Fiji, this was remarkable because the insect can breed continuously throughout the year and the variation in the rate of development, together with the two weeks duration of the oviposition period, is sufficient to cause all stages to be present simultaneously within three generations after the first eggs are laid in any locality. Yet, year after year, the lack of overlapping of generations was preserved; and the discovery of the cause of this condition, and the thorough appreciation of its significance, proved to be the key to the whole problem.

THE NATURAL ENEMIES PRESENT IN FIJI PRIOR TO 1933.

The important natural enemies already present in Fiji were only three in number:—

1. *Oligosita utilis*, Kow. (Trichogrammatidæ).
2. *Elasmus hispidarum*, Ferr. (Elasmidæ).
3. *Pediculoides ventricosus*, Newp. (Tarsonemidæ).

Of these, the first two are indigenous, while the last was undoubtedly accidentally introduced—most probably in the cargoes of ships, where it feeds upon a variety of insect larvæ in stored products. The date of arrival of this mite in Fiji cannot now be determined, but it was probably about 50 years ago.

Oligosita utilis is an egg parasite, and several individuals develop in one egg of *P. reichei*. Its life cycle covers nearly two months. *Elasmus hispidarum* is an external parasite of the larva of *P. reichei*, with a life cycle of only two weeks. It is liable to be attacked by three parasitic insects (*Tetrastichus taylori*, Ferr., and two Eupelmids not yet named) and also by the mite *P. ventricosus*. The latter is an external parasite attacking a great variety of insects living in sheltered situations.

O. utilis and *E. hispidarum* are, with very little doubt, the parasites which formerly controlled *P. reichei* effectively throughout Fiji, and they still do so in most parts of the Colony other than Lau.

THE CAUSE OF OUTBREAKS OF *P. reichei*.

The principal cause of the severe outbreaks of comparatively recent times proved to be the mite, *P. ventricosus*. The effect of the mite upon *P. reichei* and its indigenous parasites was exceedingly complicated, and it is impossible here to give a full account of it. The summary account which follows, however, covers all the more important aspects and applies to the great majority of outbreaks.

The mite attacked the larvæ (of all ages) and the pupæ of *P. reichei*. In the Lau Group it multiplied in dry weather with incredible rapidity, and in the dry season of each year it soon attained a degree of abundance sufficient to enable it to destroy all of the *P. reichei*, except adults and eggs, in any locality. This elimination of larvæ and pupæ was continued until eventually a condition was reached in which the only individuals of *P. reichei* remaining alive were a few adults. These, being active, were not liable to the attack of *P. ventricosus*, and consequently the mites had no food left and died in vast numbers of starvation. The beetles, now very rare, oviposited; and in due course their progeny also oviposited and so caused the species to be much more plentiful but to be present in a one-stage condition which was quite abnormal and which resulted from the earlier elimination of all stages except adults at the same time. Wet weather very greatly hindered the mite, and during the wet season, therefore, *P. reichei* tended to regain its normal condition of complete overlapping of generations. Before this condition was attained, however, another dry season set in, and the one-stage condition was completely restored by the mite. The effect upon the indigenous parasites was, briefly, that they were rendered absolutely incapable of exercising their normal degree of control by the absence, for long periods at regular intervals, of the stages which they required for food. They were unable to multiply continuously, and they were unable to survive, except in very small numbers, from one generation of *P. reichei* to the next. During the wet season of every year therefore, the pest multiplied without any appreciable check; and if, at the time when the weather once more became favourable for the mite, the predominant stage of *P. reichei* was the adult stage, so that the mite could not at once take advantage of the favourable weather, then *P. reichei* attained a degree of abundance sufficient to cause great damage.

In this way, in general, *P. ventricosus* caused *P. reichei*, a normally rare insect, to become a serious pest in the presence of the very parasites which normally controlled it. Had the mite not received a severe check from wet weather every year it would itself have replaced the indigenous parasites very satisfactorily, but the sudden cessation of its activities every year due to wet weather, had precisely the reverse result.

In the wetter parts of Fiji *P. reichei* was seldom a serious pest because the distribution of rainfall throughout the year was such that *P. ventricosus* was seldom provided with the very dry conditions which it required for rapid multiplication.

THE SELECTION OF A PARASITE FOR THE CONTROL OF *P. reichei*.

As soon as the significance of the activities of the mite was appreciated, it became evident that the conditions which any parasite would be required to fulfil if it were to control *P. reichei* were peculiarly exacting. It was evident, not only that the parasite would need to be able to multiply much more rapidly, relative to the pest, than the indigenous parasites, but also that it would need to be able to survive, without numerical loss, the long periods when no individuals of the pest were in a suitable stage for its attack. One of the many parasites of *P. nucifera* in Java satisfied these conditions, mainly because it attacked all the larval stages, and also the pupal stage, of its host. A parasite attacking many stages would obviously be able to find suitable hosts, in one-stage outbreaks, over a much longer period in each pest generation than one which attacked only one stage. Moreover, the period during which it would be unable to find suitable hosts would be

correspondingly shorter. The parasite selected in Java was *Pleurotropis parvulus*, Ferr. (Eulophidae). This species is one of the least important of the many which together constitute an effective control for *P. nucijerae* in Java, but there was every reason for believing that its status would be very different in Fiji conditions.

THE HABITS OF *Pleurotropis parvulus*, FERR.

P. parvulus is an internal primary parasite of larvæ (of all ages) and pupæ of *Promecotheca* spp. It is a minute but very sturdy insect, and many individuals mature in each host individual. The whole of its development takes place inside the host body, the adult parasites emerging from the empty skin of the host, inside the mine, and then escaping from the mine by biting minute, circular holes in its upper wall. The life cycle (oviposition to emergence) covers about three weeks, the egg-capacity is 80, the ratio of males to females is 1 : 4, and the adult life covers $5\frac{1}{2}$ weeks. The female oviposits through the upper wall of the mine and directly into the contained larva or pupa.

RESULTS OF THE INTRODUCTION OF *P. parvulus* INTO FIJI.

P. parvulus was eminently successful as a control for *P. reichei* within a year from the time of its first arrival in Fiji (May, 1933). It completely suppressed all the severe outbreaks then in progress on Vanua Balavu, Kanacea, Mango, Lakemba, and elsewhere. It attained 100 per cent. parasitism, literally, in all trees, even though in many outbreaks every tree, over hundreds of acres of land, contained about 4,000 *Promecotheca* individuals. A careful estimate showed that when the parasite population was at its maximum about 5,000 adult parasites were emerging in every tree every day, and that emergence continued at this rate for 10 days. In many outbreak areas not one *Promecotheca* individual escaped, even in isolated trees surrounded by forest. Moreover, the spreading capacity of the parasite proved to be as remarkable as its capacity for multiplication. The exceptional thoroughness of the work of this parasite was mainly attributable to the fact that many individuals matured in each host individual, so that the parasite population could suddenly exceed the pest population so very greatly that at least one parasite found even the most hidden or isolated mine. In short, *P. parvulus* showed itself to be capable of coping with the very exacting conditions which were due to *P. ventricosus*, and of succeeding in the circumstances in which the formerly efficient indigenous parasites had failed.

THE PERMANENCE OF THE CONTROL EXERCISED BY *P. Parvulus*.

The extreme thoroughness of *P. parvulus* had one disadvantage. On small islets, or on small coconut areas isolated by sea or forest, the pest appeared to be completely exterminated. The parasite consequently died out soon afterwards, and then, if *Promecotheca* was accidentally introduced at a later date from another area or island in which control had not been effected at precisely the same time, outbreaks were again liable to occur as before, there being no parasites of any kind to check them.

This, fortunately, appeared never to occur on large coconut estates because the pest was not suppressed at precisely the same time in all areas. A constant interchange of pest and parasite individuals took place between

the different areas, until eventually an equilibrium was established. The equilibrium was such that *P. reichei* was rare and negligible, but still present in sufficient numbers to enable the now rare parasite to survive and prevent its host from multiplying extensively.

In most islands of Fiji, other than the Lau Group, *P. parvulus* has an alternative host in the form of *Promecotheca bicolor*, Maulik, a close ally of *P. reichei* which mines in the leaves of *Flagellaria* species. In the Lau Group, the parasite has no alternative hosts, but a species of *Flagellaria* is present on all the larger Lau islands and would serve as a permanent food supply for *P. bicolor*. The writer has been informed that an outbreak of *P. reichei* has recently occurred at Nabavatu in spite of, or perhaps because of, the extremely thorough suppression of the pest which followed the introduction of the parasite in 1933. Nabavatu is typical of the isolated areas already mentioned, and it seems most probable that the parasite defeated its own ends in 1933-34 by wiping out its host and so causing its own extermination. It is likely that the introduction of *P. bicolor* into the forests around Nabavatu Estate would overcome this difficulty by providing, for *P. parvulus*, an alternative host which could never be completely exterminated because it would be present and sparsely distributed over a very wide area. It is probable, however, that reintroduction of the parasite into Nabavatu from another part of Vanua Balavu would result in permanent control, provided the parasite were liberated at a time when the outbreak were still in its early stages. An existing outbreak, if already far advanced, could first be suppressed by reintroducing the parasite from elsewhere, and this introduction could be followed nine months later by another which would serve to check any further outbreak which might be developing. Total parasitism is possible only when the host is abundant, and if it can be arranged that the parasite is introduced at a time when its host is uncommon it is probable that both will survive and that a satisfactory equilibrium will be maintained.

There is every reason to believe that in all large areas the control brought about by *P. parvulus* will be permanent and that no further introductions will be necessary. In smaller, isolated, areas, on the other hand, outbreaks are evidently still liable to occur, and in such cases the right procedure will be, first to introduce the parasite again before an outbreak becomes severe; and then, if this should not give permanently satisfactory results, to introduce *P. bicolor* together with the parasite, the former being liberated on its food-plant in the forest and the latter some distance away in a coconut area.

THE DETECTION OF ADDED WATER IN MILK.

By

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THE analysis of a sample of milk for the determination of fats proteins lactose and mineral constituents is not a difficult process where the normal facilities of a chemical laboratory are available. Normal chemical methods, however, fail to decide directly between a normal and an abnormal milk. This abnormality may be due to peculiarities in the beast producing the milk or to the direct addition of water for the purpose of increasing bulk.

It is to be remembered in this latter case that normal milk contains approximately 87.0 per cent. of water and therefore in order to detect the addition of water, the methods used must be capable of determining water not normal to the milk.

Richmond and Veith as a result of the analysis of many thousands of milk samples came to the conclusion that normal cow's milk had approximately the following values for its constituents:—

Fat	..	..	..	3.7	per cent.
Sugars	..	..	..	4.7	..
Pro.eins	..	..	..	3.4	..
Ash	..	..	..	0.75	..
Water	..	..	..	87.30	..

If the figures indicated above are grouped into fat and solids not fat it is found that normal milk should have values of 3.7 per cent. fat and solids-not-fat of 8.85 per cent.

Similar researches carried out in New Zealand, Australia, Canada and on the Continent substantially confirmed these figures.

Legislation was therefore introduced in the various countries to define what was considered to be normal milk and the standard usually adopted states that normal milk shall be the milk taken completely from a healthy beast and shall have a fat content of 3.2 per cent. fat and 8.5 per cent. solids not fat. This standard is in operation in Fiji at the moment although evidence has been accumulated to show that the fat figure is normally much in excess of this minimum requirement, but that the solids-not-fat are frequently much lower.

The practice has been therefore to consider that all milks which do not come up to this standard are adulterated unless the contrary is proved. This assumption may cause undue hardship since there are many cases on record of genuine milk being below the standard demanded. This can be attributed either to breed of cattle, milking practice, poor feed, small herds, &c. In some countries, such as New Zealand, the milk from such cattle is directed to a butter or cheese factory and not offered for sale. Again, a magistrate would naturally take a different view of the case if the sample is intrinsically poor and not intentionally diluted but where he has only a standard to guide him in making a decision he is in the position of not being able to discriminate between a dairyman who intentionally waters his milk and the unhappy producer of normal yet poor milk. Again it is not generally recognised that the standards laid down are considered to be minimum standards and there are many herds that produce milk of a better quality. A dairyman may therefore dilute a good quality milk

down to the minimum standard and although committing an offence by adulteration so that his milk is not now normal as defined he is able to escape penalty because he has supplied a milk conforming with the standard. Water may thus be added up to seven per cent. without detection.

Apart from lowering the food value of a sample and defrauding the public, adulteration must always be considered a serious matter in the tropics since one cannot depend upon the bacterial purity of the water used for adulteration.

Within recent years the hands of the Analyst have been considerably strengthened by the adoption of two physical methods and one chemical method for the detection of added water and it is proposed briefly to discuss the merits of these methods and their reliability.

(1) *The chemical detection of nitrate.*—Normal milk does not contain nitrate nitrogen unless such has been added as a preservative. Nitrates occur in most drinking waters and can be detected in very small quantities by means of a colourimetric method using an organic chemical reagent known as diphenylamine. It has been shown that nitrates taken by mouth are excreted in the urine and do not appear in the milk. The addition of nitrate to a milk for preservative purposes would be extremely rare and therefore the detection of nitrates in a milk supply would be strong evidence for suspecting the addition of water and when it can be shown that nitrate had not been added as a preservative the evidence is conclusive. This method fails when nitrates do not occur in the water supply. This is exceptional for most water supplies which usually contain nitrate nitrogen of the order of 0.01 parts per 100,000. In Fiji, however, our nitrate nitrogen is usually much lower than .001 parts per 100,000 and in many cases it is impossible to detect the nitrate ion. This method therefore though valuable in England "when nitrates approach 0.5 parts per 100,000" cannot be used satisfactorily in Fiji.

(2) *Refraction of the milk serum.*—This method is carried out by determining the refractive index of the milk serum suitably prepared, by an instrument known as the Zeiss immersion refractometer. Elsdon (*Analyst* 1927, p. 193) has shown that (1) milk with normal solids not fat gives a scale reading of 38 to 39 degrees, (2) that the addition of water reduces this figure by approximately two scale divisions for every 10 per cent. of added water and (3) the development of acidity increases the refraction by 0.2 degrees for every increase of ten degrees of acidity. He was not able to state whether the degree of acidity resultant on souring makes the reading unreliable. This method cannot differentiate between a milk that has been watered and one naturally poor in solids not fat and therefore appears to be less reliable than the solids not fat figures as an indication of watering.

(3) *The freezing point of milk.*—The osmotic pressure of milk is dependent upon the osmotic pressure of the blood of the animal supplying it. The osmotic pressure of blood is subject to very slight variation and may be considered under normal circumstances to be constant. Similarly the osmotic pressure of milk will be constant. The freezing point is a direct measure of the osmotic pressure and therefore for normal milk the freezing point may be considered to have a constant value or at least be subject to little variation. The osmotic pressure is determined by the soluble materials such as lactose and mineral salts present in true solution. The insoluble solids such as fat and protein do not effect the osmotic pressure. If there is a decrease in one soluble constituent the metabolic processes of the animal balance this by an increase in another soluble constituent and thus maintain a definite osmotic pressure. Thus a deficiency in lactose would be counter-balanced by an increase in mineral salts.

It is thus appreciated that the osmotic pressure as determined by the freezing point is a direct measure of the soluble solids.

It is known that the presence of soluble solids depresses the freezing point of a solvent. In the case of milk the solvent is water which freezes at 0 degrees Centigrade and the soluble solids are lactose, mineral salts and lactic acid if souring has commenced. If the milk is fresh the soluble solids depress the freezing point of the water and in normal milk this depression amounts to about -0.546 degrees C. with an extreme range of variation between -0.53 degrees to -0.56 degrees. If water is added to a milk there is consequently a smaller percentage of soluble solids contained in the same volume and hence the freezing point depression will be less. As water is added so the freezing point will approach nearer and nearer to that of the pure solvent that is 0 degrees C.

Several types of apparatus are used for this determination, *e.g.*, (1) Hortvet cryoscope as adopted by the Association of Official Agricultural Chemists in America and by the Society of Public Analysts in England. This is described by Elsdon and Stubbs (*Analyst*, 1930, p. 423). (2) Andrew's Apparatus (*Analyst*, 1929, p. 210), which is official in New Zealand and (3) Monier Williams Cryoscope (*Analyst*, 1933, p. 284) by means of which fundamental investigation were made in regard to the necessary corrections to be adopted to determine the true freezing point.

The apparatus best adapted for routine control is undoubtedly the Hortvet and this type of apparatus has been adopted for Fiji conditions. The apparatus has been described elsewhere and experience has confirmed its reliability and shown that the most important points to be considered are: (1) rate of stirring; (2) super-cooling; (3) rate of cooling and above all (4) the accuracy of the thermometer.

In regard to the first three factors the technique of the A.O.A.C. as modified by J. R. Stubbs has been adopted as a result of a series of comprehensive investigations which he has carried out (*Analyst*, 1935). The thermometers in use by the Department are standardised by the National Physical Laboratory over the requisite range and are further corrected in accordance with the A.O.A.C. method.

Many tens of thousands of freezing point determinations of milk have confirmed the value of the method and also the opinion that, of all the variants in fresh milk, the freezing point is the one which most nearly approaches constancy.

It is possible to read the thermometer with an accuracy of 0.002 degrees centigrade and since the addition of 1 per cent. of water reduces the depression by .005 degrees it is thus possible to detect the addition of very small quantities of water.

The value of the test lies not only in its ability to distinguish good from poor milk but also to distinguish poor quality from watered milks. As has been pointed out above, the osmotic pressure of a normal milk is fixed and any changes which occur during metabolism do not markedly alter the sum total of the effects that give rise to constant osmotic pressure, although there will be relative quantitative differences in the milk components affecting the osmotic pressure. It has also been stated that abnormal milk has a greater depression than that accepted for normal milk and hence such abnormalities could not effect the value of the test in the detection of added water.

In conclusion it may be stated that the Analyst has secured in the Hortvet cryoscope a valuable weapon in the service of milk analysis and the general adoption of the process will do much to prevent the pernicious habit of deluting milk which has been found to be only too common in Fiji.

THE FEEDING OF WORKING HORSES

By

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WHILE the principles of feeding are the same with all animals this note dealing especially with the horse may prove of local interest since there are some 12,000 horses in this Colony.

It is a recognised axiom in feeding that the animal body makes the best use of any food if the different food constituents are in correct proportion to each other; while if the proportions are incorrect some portion of the food is wasted or may even produce harmful results. It should also be remembered that the stabled horse has no power of selection but has to eat what he is given or go without.

Different foods contain the required constituents in different amount, some being rich in one and poor in another, other foods containing them in the correct proportions. Food constituents are divided into two classes—organic and inorganic.

The organic materials are all those constituents of the food excepting water and mineral solids. The latter constitute the inorganic portion. The organic constituents are, firstly, those containing nitrogen, known as proteids or protein containing foods. Chemically they contain the elements carbon, hydrogen, oxygen, sulphur, nitrogen and sometimes phosphorus. The horse derives most of his protein requirements from the order of plants known as legumes and from various concentrate foods such as maize, oats, cotton seed meal, coconut meal, &c.

The second of the organic constituents consists of oils and fats. These have a chemical basis of carbon oxygen and hydrogen, and their functions are to repair and renew fatty tissues while they also yield heat and energy. If given in excess they are stored up for future use especially in the form of fat, throughout the greater portion of the body. The excess of fatty food does not normally produce anything worse than soft condition which means the inability to do immediate hard work.

The third of the organic food constituents is the carbo-hydrate group represented by starches and sugars. These have the same chemical elements as fats, namely carbon, oxygen and hydrogen, but in this case the oxygen and hydrogen are always in the proportion to form water. The carbo-hydrates constitute the bulk of nearly all natural food and their functions are to supply heat and energy. They cannot be converted into proteids but they can be converted in the body into fats, indeed, it is probable that most of the body fat is derived from the carbo-hydrates. Like the fats they are completely oxidised in the body and leave the body in the form of carbon-dioxide and water.

The fourth organic food constituent consists of crude fibre, which is composed chiefly of cellulose which forms the framework of plants. Fibre is true carbo-hydrate but is classed separately because it is regarded as having no nutritive value since the digestion or solution of cellulose requires all the energy derived from it in the process of digestion.

The organic portion of the food consists of the mineral salts of which perhaps common salt (*sodium chloride*) is the most important to the adult animal. These salts assist in keeping the blood in correct order and form the source of hydrochloric acid in the gastric juice which materially aids the digestion. The complete withholding of common salt from food would cause the death of the animal from starvation owing to the proteid matter not being digested. Common salt usually does not exist in sufficient quantity

in the natural foods (grasses) for hardworking horses. If these animals are stabled, an addition should be made to their food of common salt, either in the mash or in the form of rock salt in the manger. In the vicinity of Suva, however, this is not so important, since the horses will always avail themselves of the opportunity of getting sufficient salt from the sea if their bodies feel the need of it. Phosphates, calcium, potassium, sodium, magnesium and iron salts are all essential to the repair and growth of different parts of the body. Phosphates of lime, potash, and magnesium go to the formation of bone and nervous tissue. Muscle tissue is rich in potash and iron helps to form the hæmoglobin or the red colouring matter of the blood.

The last food constituent is water and when it is remembered that almost two-thirds of the body is composed of water there is no difficulty in comprehending its necessity as a food. Its uses in the food are for the solution and conveyance of the food to the different parts of the system, the excretion of effete products, the regulation of heat by evaporation both from the lungs and the skin, and the regulation of all chemical and mechanical functions of the body.

A balanced food must therefore consist of proteids, fats, carbo-hydrates, salts and water. No two cereals contain these constituents in the same amounts or proportion. Thus, peas and beans contain a high percentage of proteids, linseed contains a high percentage of fat, while maize contains a high percentage of soluble carbo-hydrate, and none of these is in itself a balanced ration. One has next to consider the nutritive ratio or the proportion in which the food constituents are arranged towards each other, and what are the best ratios or proportions of the proteids, carbo-hydrates, fats and cellulose for a food to supply its highest economic value while at the same time maintaining the animal in perfect health. One should endeavour to get the best out of the horse by the cheapest method of feeding consistent with the good health.

FODDERS AND FOODS AVAILABLE IN FIJI.

The range of local fodders is strictly limited. Available pastures in Suva district contain sensitive plant and a mixture of grasses. The sensitive plant is a legume and is therefore rich in protein. The mixed grasses contain chiefly carbo-hydrate and therefore, if there is sufficient bulk of good pasture in the paddock, a more or less balanced ration can be selected by the grazing horse. Other grasses are Para and Guinea grass. Where the available grazing area is limited the above mentioned grasses can be cut and fed to the horse either as cut or in the form of "chopchop," which is simply the grass which has been put through a chaff cutter. Both Para and Guinea grass are rich in carbo-hydrate, and poor in protein and do not therefore constitute a balanced ration.

Available concentrates include coconut meal, which is cheap, rich in protein, fat and carbo-hydrate but has too close a nutritive ratio to be a balanced ration. Good quality rice bran which is practically free of husk, makes excellent food and has the same advantages as coconut meal.

Maize is generally available for the greater part of the year though prices vary considerably at present. It is better fed crushed than whole and is much relished by horses.

Molasses is a good feed consisting almost entirely of carbo-hydrate (sugar) but it is an awkward food to handle.

Available imported foods are oats, chaffed hay, bran and linseed but for working horses there is little need for these though oats provide an excellent concentrate food for getting race-horses into condition.

Imported wheaten and linseed bran may usefully be kept for medicinal puposes.

It has already been mentioned that the ration must be balanced, that is it must contain a proportion of protein to carbo-hydrate and fat in such a ratio that good digestion is obtained and the best advantage is gained from them. Natural pastures often do not form a balanced ration and with the exception of the "sensitive" plant, are poor in proteins. Concentrate should therefore be fed as an adjunct to grazing in order to maintain animals in the best condition to satisfy the eye and to perform their work. By supplementing the grazing ration or cut grass ration with mixtures of coconut meal, rice meal or maize, the above desired effect can be readily achieved.

The digestible nutrients of para grass, when compared with coconut meal¹ and rice meal, are given for comparison:—

	Total dry matter in 100 lb.	Digestible nutrients in 100 lb.				Nutritive ratio.
		Crude protein.	Carbo-hydrate.	Fat.	Total.	
Para grass	27.2	0.8	14.0	0.3	15.5	1 : 18.4
Coconut meal	90.4	18.8	42.0	8.1	79.0	1 : 3.2
Rice meal	89.9	7.9	38.1	8.8	65.1	1 : 7.3

It will be seen that the Para grass has a very wide nutritive ratio and is therefore not a very complete food whilst the coconut meal has a very close ratio and is therefore too rich. Rice bran could not be used as a complete food owing to lack of sufficient crude fibre to form bulk. For a working horse the ideal is a nutritive ratio of about 1 : 7 and this is obtained by feeding a ration as follows:—

	Total ration.	Dry matter.	Crude protein.	Carbo-hydrate.	Fat.
	lb	lb	lb	lb	lb
Para grass	50	13.6	0.4	7.0	0.15
Coconut meal	6	5.4	1.128	2.52	0.486
Rice bran	3	2.7	.237	1.14	0.264
Total ration	59	21.7	1.765	10.66	0.9

This gives a total dry matter amounting to 21.7 lb per day which is a fair average ration for a working horse, and has a nutritive ratio as 1 : 7.2 which is quite reasonable.

The formula for the nutritive ratio is:—

$$\frac{\text{Carbo-hydrate} + (\text{fat} \times 2.25)}{\text{Protein.}}$$

WATERING.

Horses should always be watered before being fed. A considerable amount of fluid is required for the production of gastric juice and watering before feeding helps this process. Watering after feeding not only dilutes the gastric juice and so weakens its action but also washes through the stomach a quantity of undigested food, the nutritive value of which is lost even if nothing worse in the form of bowel trouble occurs. There is some prejudice against giving horses water when they are sweating but this is an overrated prejudice. Such an objection might have foundation in a cold country but in Fiji water is never so cold that it will produce harmful effects. This abolishes the objection to watering whilst the animal is hot.

In nature the horse is a slow but more or less continuous feeder. Large bulky feeds with short time for feeding are therefore not indicated. One should bear in mind the axiom "little and often" and when working a horse allow him to feed as often as is possible.

It is hoped that this brief note may prove useful to horse owners in the Colony.

KAU VULA (*Endospermum* sp.).

By

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Native Field Assistant.

THE Kau Vula is known as "Lekutu" in Namosi and as "Vulavula" in Vanua Levu. It is a rapid growing tree attaining a height up to 70 feet, according to the location.

According to Mr. R. A. Sykes' Report "they are widely distributed over the intermediate rain forest of Viti Levu, being particularly common in the forest of Serua, Namosi, Waindina and the lower part of Rewa." In general it appears to favour wet but not sour situations, and is found in the wet parts of the forest or confined to the lower parts of the slopes. The tree makes a nice shade by its large ovate leaves which are generally cordate at the base—the petiole is 2-4 inches long and the blade 4-9 inches long or even longer. The bark is smooth and brown with a yellow slash below, the fruits are divided into three cells forming one capsule with three seeds to each fruit. The timber is white, soft and light and makes an excellent timber for fruit packing-cases, but quickly becomes spotted with fungus in damp weather. It is also popular for firewood in native villages, as it burns well when it is dry.

Seedlings are obtainable from around the forests mentioned above and Fijians should be encouraged to plant up areas in the vicinity of their koros for the future supply of firewood and case timber.

In planting the holes should be dug two weeks before planting and filled in with available top soil. The holes should be spaced 10 feet apart, and the bigger the hole up to two feet the better. Planting should be done when the soil is thoroughly wet and an occasional weeding for the first two years is essential.

HARVESTING, CURING AND FERMENTING TOBACCO.

By

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EXPERIMENTAL work on tobacco has recently been started at the Singatoka Agricultural Station and the following notes are furnished as a progress report to indicate the general methods employed in handling the tobacco crop. During the past season two methods were employed:—

- (a) single leaf;
- (b) whole plant.

The single leaf method consists of harvesting each leaf separately as it attains the correct stage of maturity. After wilting, the leaves are strung by piercing the mid rib of "tie" wire so that the leaves are back to back and blade to blade alternately. The wire when full is strung from end to end of the curing "bure" (native type thatch building 30 feet by 15 feet). The whole leaf method consists of cutting the main stem about three inches above the ground at the stage when the greatest number of leaves are at the optimum stage of maturity. This necessarily means that some of the lower leaves will be over mature while some of the top leaves will be under mature. The cut plants are allowed to wilt in the field before being conveyed to the curing "bure" and there are two methods by which the whole plants may be handled in the curing room. One is to attach a loop of twine (*Vau* is used at the Station.) to the thick end of the stem. The other method is to split the main stem from the tip towards the base to within three inches of the end. Sticks about $\frac{1}{2}$ inch thick and 12 inches long are thrust into the thatch of the bure and the plants are hung from them, the sticks being placed so that each plant just touches its neighbours. Free circulation of air is essential but wind or strong draughts are avoided. Care in handling is required at all times and particularly when harvesting as the leaf is then turgid and brittle and any bruising will cause the finished product to appear much darker and probably "blotchy" by comparison with carefully handled leaves. It is advisable to harvest in fine weather only after a few fine sunny days and when the sun is well up and all dew has disappeared.

After the plants are harvested by either of the above methods they are allowed to wilt in the field. A temporary palm leaf structure is useful for wilting as the direct sun tends to cause sun scald. The object of the wilting process is partly to reduce the moisture content but chiefly to toughen the leaves for subsequent handlings. The time taken to wilt varies from, say, half hour on good drying days to perhaps two hours. The crop is then conveyed to the curing house, light wooden frames covered with sacking and built like an ambulance stretcher, being used for the purpose. Two men handle this stretcher with a minimum of bruising.

In the process of curing the plants are hung in the curing room as indicated above and the process of curing takes from four to six weeks, depending upon the variety of the weather conditions, and the method of harvesting, (the single leaf curing quicker and more evenly than the whole plant, there being less moisture to be eliminated). Early last season, while drought conditions prevailed, it was found that the leaf dried too quickly, even with the building closed all day and opened at night. It became necessary therefore, to increase and maintain the humidity within the curing house and this was achieved by periodically sprinkling water over the earthen

floor. This method appeared to suit local conditions satisfactorily. Later in the season after copious rains had fallen the problem was to reduce the humidity as some of the leaf was showing mould (particularly where whole-plant harvesting had been employed). This problem was solved by making small braziers (a one-gallon paint can is satisfactory) and burning charcoal fires in the curing house. Charcoal is probably the only suitable and easily obtained fuel for this purpose as it gives no smoke or odour which might be assimilated by the tobacco. Probably lines of clean dry coconut shells as used in small copra driers would also be satisfactory but these have not yet been tried at this station.

The curing process is carried on until the leaf is quite dry—a reliable index being the mid rib which should be quite tough and almost brittle—and the colour has changed over the whole leaf—to an even brown. Colour will vary greatly according to the variety, a light golden for some of the cigarette types, a dark brown for pipe and cigar filler types and a greenish brown for the best cigar wrapper types.

When the leaf is sufficiently cured it is taken down and prepared for the next process, opportunity being taken at this time to discard any badly damaged, improperly cured or mouldy leaves. Grading for size, colour, texture, &c., may also be conveniently done at this stage. In fermenting, the leaves are made up into "hands" of about 20 leaves and stacked into as large a heap as there is tobacco available—up to, say, 2,000 lb. This heap is covered with a tarpaulin or sacking and much attention must be given to it at this stage. It is necessary to see that the tobacco does not heat too much, 40° C. being a critical temperature. It is advisable to break down and restack the heap placing the upper "hands" at the bottom at each successive restacking. For the first week this should be done once daily, during the second week every other day, and for the following three weeks, once each three or four days. The leaf is then packed into sound wooden cases (zinc lined match cases are very suitable) covered with sacking and heavy weights are placed on top. About once each three weeks the leaf is turned out of the boxes and replaced, the position of top and bottom "hands" being reversed.

To make the best mellow tobacco it is advisable to continue this last stage for not less than one year, and preferably longer.

ARECANUTS.

By

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Director of Agriculture.

FOR small holdings the arecanut would appear to be a potentially useful palm in Fiji and hence these notes derived from observations compiled by the writer during his sojourn in Malaya are recorded for future use.

The arecanut palm (*Areca catechu* L.) is said to have originated from wild species still found in the Philippine Islands (I) and is seen growing occasionally in gardens throughout Fiji and there is little doubt that it was introduced by Indian labourers for chewing purposes.

The palm grows best in rich well drained alluvial soils near the coast, but has also been seen inland at higher elevations.

The fruits of the palm are known commercially as "penang," "Areca" or "betel" nuts and they have a considerable economic value in India, to which large shipments are annually despatched from Java and Malaya. Malaya, for instance, over the last dozen years exported approximately 22,000 tons per annum of an annual value of some £700,000.

The hard mottled grey or brown nuts which are mainly used as a masticatory by natives of Eastern races are normally in steady demand in India.

Amongst the minor use of "betel" nuts, mentions may be made of its employment in the production of dyes and tanning material. The powdered nuts are also used as a dentifrice, and as a verifuge in veterinary practice, for, as pointed out by Sands (2) the nuts are astringent and slightly acid to the taste and possess narcotic and anthelmintic properties due mainly to the alkaloid arecoline; though three other closely allied alkaloids have also been isolated from them. Other uses for the palm are as boundary fences, building materials, native house flooring, &c.

The main features of the palm are its tall, erect, slender unbranched, annulated stem, the compactness of its crown of dark green pinnate leaves, its pendulous bunches of ovoid green or orange (ripening) fruits and its tough fibrous radiating roots. Under favourable conditions, flowering commences when the palm is about five years old. The flowers have been described by Sands (2). Normally, self-pollination is precluded by the sequence of the male and female phases, but occasionally when growth is rapid, palms have been observed in which the male phase of the most recently opened spadix overlapped the female phase of the spadix immediately below, thus making self-pollination possible.

The fruit normally takes six to seven months to ripen when it becomes bright orange red in colour and about the size and shape of a hen's egg. The number of spadices produced per annum and the number of ripe fruits per spadix vary with the variety, with the general conditions of growth and with the age of the palm, but the better commercial types of medium age and under good conditions appear to produce three to four bunches per annum, each bunch carrying 100—250 fruits according to variety. Young palms will not produce so abundantly and though fair crops can be reaped at seven years after planting, the palms take 10—12 years to reach full production, and are reputed to bear remunerative crops under favourable conditions for over 25 years.

The germination of fresh seed commences about six weeks after sowing and continues for a further six weeks or so.

In the Far East the palms are grown chiefly in peasant homesteads in varying numbers from a few up to about 80 palms to the acre, interplanted with coconut palms and various fruit trees, with which they compete for available nutriment and light, or they may be found as boundary fences around the small holdings. Under these conditions the palms rarely get any cultivation save an occasional slashing of weeds and are usually grown merely for home consumption of nuts, but may become a minor financial asset in times of difficulty when the fruits can be sold or the palms rented to local dealers, usually Chinese, who purchase crops from small cultivators for the curing of nuts.

Where cultivation hardly exists, crops will naturally depend on soil and moisture conditions, and while good rich alluvial soil may result in a production of better crops the average production from mature palms is about 4 lb per palm or about 1,800 lb per acre per annum if an average stand is regarded as 450 palms per acre. Normally under fair conditions, crops of 1,100 lb should be derived after the seventh year and full production (1,800 lb) should be reached in the eleventh year after planting and is said to be maintained for over 20 years. Doubtless this period will be found to depend largely on growing conditions and should be influenced considerably by judicious cultural and manurial treatment. In Mysore, where climatic conditions are severe, arecanuts have long been established on a large area and the average crop is said to be about 2,000 lb though in the better areas crops up to 4,000 lb per acre have been attained and palms up to 40 years old are said to be remunerative (3).

VARIETIES.

In Malaya the better known commercial types of which there are only about a dozen varieties, have already been described under their Malay names by Sands (2). They are mostly distinguishable by the size and shape of their fruits and of their kernels, the amount of colour in the endosperm and the taste. They include the Pinang kuning, jambu (or lemak), betul, rambai, telur, kerdu, seluang, kechil, gasing, malan, kelat and buntot tabuan of which the first eight mentioned are the most important.

In Fiji the only variety of common occurrence is similar to the "Kechil" type in Malaya, but recently a few of the other better Malayan types have been introduced.

GRADING.

In Malaya, arecanuts are prepared for export in three forms (a) split, (b) whole (red and white) and (c) sliced. The quantity of each form exported varies from time to time according to demand which appears to be affected considerably by general economic conditions particularly in India and Burma, to which the bulk of exports are sent.

"SPLITS."

The small dealers pay little attention to grading as long as their product is marketable, but in Singapore the big dealers take the following characteristics of the nuts into consideration in differentiating "splits" into three grades—1st, 2nd and 3rd quality:—

- (a) size, the larger sizes being the better;
- (b) the evenness of the cut, as jagged surfaces are wasteful in use and packing;
- (c) the colour, which must be as uniform as possible;
- (d) the "flower" which should be well defined and white;
- (e) the dryness, on which the weight and keeping quality largely depend;
- (f) the cleanliness, as affecting the general appearance of the product;
- (g) the shape of the half nuts, which should be as nearly uniform as possible.

It is generally considered that the best quality "splits" can only be obtained if the fruits are picked when fully ripe and when the curing is gradual and uninterrupted. Usually, in preparing "splits" the fruits, split longitudinally, are kiln dried by large dealers (or sundried by the small dealers) for three days, before removing the husks with an instrument like a short screwdriver and for a further two or three days or more, after husking. The average price of "splits" in September, 1936, in Singapore was 18s. per cwt.

Large nuts can be more efficiently and profitably handled for "splits" than small nuts, hence varieties which produce fruits with large kernels should be grown to supply these popular grades. The adoption of "splits" as a marketable form for arecanuts would appear to be mainly a localised practice in Malaya and no doubt is due to local difficulty in drying whole nuts during uncertain weather.

"WHOLIES."

Whole nuts are divided into two groups, white and red, according to the stage of maturity of fruit when harvested and to the treatment given in curing. "White wholes" consist of sundried nuts obtained from fully matured fruits, while "red wholes" are roasted nuts derived from fruits which have been picked when about 80 per cent. ripe. In each of these two groups, three grades are recognised, the grading being based on the following features in Malaya:—

- (a) size of nut;
- (b) dryness, as affecting weight, hardness and extent of curing;
- (c) colour, which should be uniform (light brown for "whites," bright red for "reds");
- (d) cleanliness, freedom from dust, fibres or foreign particles;
- (e) "flower," white and well developed.
- (f) shape; uniformity is desirable (very immature nuts shrink, become discoloured and rot at the core).

In these groups small nuts are desirable because they are more easily dried and are said to be of better flavour and keeping quality than large sizes. Also being sold by weight, consumers prefer a larger number of small nuts per given unit than a smaller number of larger nuts, because if a large nut is found to be defective when cut open the loss is proportionately greater than with a small nut. With small nuts less breakage is incurred in ramming them into sacks than with large nuts—an important factor, since the nuts must be unbroken and uniform in size to command the best prices.

Prices in September, 1936, in Singapore for "wholes" ranged from 9s. to 13s. per cwt. for "reds" and about 2s. per cwt. less for "whites."

The material differences in prices are said to be due to the fact that the "reds" being under ripe, contain much gum and are therefore better for dyeing purposes for which they are used in India. There is also a good market in Saigon for this class as Annam and Indo-China consumers prefer the gummy product for chewing. The "reds" when thoroughly dried, retain their quality in storage for a considerably longer period than "whites." Moreover, best quality "red" nuts are lighter than the same quality of "whites" so that equal weights of each quality will contain a materially larger number of "reds" than of "whites," which gives the "reds" a higher economic value. For medium qualities the difference in weights is distinctly smaller, while in third grade the "whites" tend to be less in weight than the "reds."

"SLICED."

"Sliced" arecanuts are best produced from fruits which have been harvested when about 70 per cent. mature. As soon as possible after harvesting, the under-ripe fruits are husked, sliced transversely and roasted quickly and uninterruptedly; sun curing is too unreliable, as delay in curing causes distortion and discolouration of the final product. The grading of "sliced" nuts depends mainly on the following easily observable characters in the individual slices:—

- (a) thinness; the thinner the better down to 1 mm.;
- (b) flatness; curling should be avoided;
- (c) colour (fairly dark red) and brightness;
- (d) "flower," white and well developed;
- (e) degree of dryness, as affecting keeping quality, weight and hardness;
- (f) cleanliness, as affecting general appearance;
- (g) slices should be entire and of uniform thickness.

Average prices for "slices" in September, 1936, in Singapore fluctuated around 21s. per cwt. for medium quality.

Slices are mainly prepared for export to Bangkok and the Coromandel coast of India. It is of interest to mention that a turnip cutter can be used for slicing as an aid to speeding up the curing process.

CURING.

Small dealers, mostly Chinese shop keepers, supply the bulk of the local production of dried arecanuts for export, through large dealers at the main ports, who sometimes mix small consignments, re-dry and separate them into three grades.

Curing methods are crude, and as already mentioned, little attention is given to grading by the small dealers, who frequently pick their fruits under-ripe to reduce the chance of theft. In some cases, ripe and unripe fruits are separated and converted into different products, well ripened fruits being used for "white wholes" and "splits" while under-ripe fruits are converted into "red wholes" and "sliced," grades; but frequently no such differentiation is made, so that the average product received from small dealers is poor.

The usual method of curing adopted by the small dealers is that of air or sun drying for "wholes" and "splits" and of artificial heating for "slices," though the best quality "splits" and "red wholes" are also often kiln dried.

In the preparation of first quality arecanut "slices" instead of kilns, sometimes a series of large shallow iron pans is used, the whole "factory" being covered by a large palm thatched roof.

In the "factory" one labourer can attend to the stoking of all the fires, which are made of charcoal, requiring little attention and giving no smoke; to the transfer of drying "slices" from one pan to another at intervals of five to ten minutes in order to turn over, mix and prevent "slices" from burning, and to the portorage of the nuts in all stages of preparation.

Women usually husk the under-ripe nuts and slice them deftly with well sharpened knives, each nut giving 15 to 25 fine slices according to size.

Commonly, small dealers use a thin sheet of iron some four feet square supported on a brick wall five to six bricks high, as a kiln for drying slices. The sheet iron is perforated by many holes about a quarter of an inch in diameter, spaced one to two inches apart, and coconut shells are used for

heating. The slices, cut after husking partially dried nuts, are placed on the heated iron sheet for 30—50 minutes, and kept stirred to prevent burning after which they are deemed to be dry. The small dealers fully realise the difference between a well-cured and a badly-cured product, but take little trouble except in the preparation of "slices," and even these are often over heated and burnt, while "splits" and "wholes" are frequently dulled by interrupted drying often resulting from exposure to rain. In Fiji the retail prices in Indian stores are reported to fluctuate around 1s. per lb for "slices."

GENERAL.

Arecanut palm seedlings are usually amongst the first plants to be established in new holdings in Malaya after the jungle has been roughly cleared so that they enjoy very good soil conditions which promote quick and vigorous growth.

Once the palms are well established their cost of upkeep is negligible, since, as has already been stated, cultivation is not generally practised in arecanut groves.

In Fiji, the crop matures mainly between September and November and there is usually a steamer sailing directly for Calcutta in November–December so that this crop if developed on a sufficient scale could be utilised to supply cargo to the direct Indian steamer and to bring in remunerative returns for much land now idle.

Judging by observations, there is little doubt that locally grown palms would produce crops well up to those derived from haphazard methods in Malaya, hence in areas where easy transport facilities exist profits varying from 2s. to 5s. per cwt. according to type and quality of product and the market demand in India should be realisable.

In addition, there is a small local demand for nut for chewing since approximately one ton of nuts is imported monthly worth about £250 per annum for this purpose and there is little doubt that this demand would increase if local supplies were augmented. Furthermore the general utility of the palms for fencing and domestic purposes should prove an asset to the small holder.

Efforts are being made to establish large numbers of these palms in suitable areas but progress must be slow owing to many other communal calls on the time of the peasant and to the general lack of any immediate urge to augment his labours.

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CANDLENUT OIL.

By

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ALEURITES Moluccana is a tree widely distributed throughout the Malay Archipelago and Polynesia and is known in Fiji as "lauthi" or "tuitui."

The seed of this tree contains a drying oil and from the kernels there is obtained on extraction with a suitable solvent 58 per cent. to 60 per cent. of a light yellow coloured oil. The cold expressed oil after filtration is almost colourless, but extraction with hot petroleum ether gives a brown coloured oil with an unpleasant odour.

According to Wright (*Oils Fats and Waxes*, 3rd Edition, 1921) the oil contains the glycerides of oleic, linolic, stearic, palmitic and myristic acids and, from its marked drying properties, linolenic acid is probably present. This has been confirmed by Philippine workers for similar oil from a related species (*Aleurites triloba*).

The oil readily becomes rancid and develops large amounts of free fatty acid. Samples recently examined in the laboratory gave acid values of over 40.0. When candlenut oil is boiled it produces a varnish which dries with even greater rapidity than boiled linseed oil. The soap produced from this oil resembles that obtained from coconut oil.

The value of a drying oil for paint or linoleum manufacture depends upon a property known as thickening when exposed to air oxidation. The oil dries and when spread out in a thin layer the oil hardens and forms a solid elastic film. Linseed oil and tung oils (*Aleurites Fordii* and *A. montana*) possess this property in a marked degree, making them valuable vehicles for pigments in the paint industry.

Aleurites moluccana also possesses drying properties somewhat similar to linseed, nevertheless from information obtained by the Department of Agriculture from interested firms in Australia it is considered to be somewhat inferior to linseed and would be of interest to firms concerned if it were marketed at a price somewhat lower than that offered for the latter oil. In other words the trade view the oil as a substitute for linseed and no doubt at a cheaper figure it would be mixed with the higher priced linseed.

According to Wright (*Agric. Circular Dept. of Agric.*, Fiji, 1921) the oil from "lauthi" nuts was used as an illuminant in Fiji before the advent of Europeans and according to the *Bulletin* of the Imperial Institute (1919, 17. p. 591) the export of candlenut oil was an important industry in the Philippines. Recent information from the Imperial Institute, however, indicates that there is little if any demand in England and America for the oil. This is no doubt due to the comparatively low price of linseed, the superior drying quality of tung oil, and irregularity of supplies of candlenut.

It is interesting to note that according to John Horne (*A Year in Fiji*, London, 1881, p. 190) small consignments of candlenuts were exported from Fiji. He states that exports were as follows:—

1875	value of export	..	£65	0	0
1876	"	..	£1,562	9	0
1877	"	..	£3,040	0	0
1878	"	..	£3,545	0	0

In 1877 the price paid on the beach for candlenuts was £10 per ton. Prices for linseed oil for the periods quoted above are not available, but no doubt were well over £45 per ton. The present (November, 1936) price for linseed oil in London is in the neighbourhood of £27 per ton.

It was stated by the Imperial Institute (*Bull.* 18, p. 25, 1920) that nuts sent from the Cook Islands consisted of 68 per cent. shell and 32 per cent. of kernel containing 4.5 per cent. moisture and 63.7 per cent. of a pale yellow oil with an iodine value of 158.5. It was further stated that the untreated oil dried very slowly but gave better results in this respect on heating. The oil was valued at £40 to £44 per ton with linseed at £54. With linseed at £27 per ton therefore, candlenut oil would be expected to realise about £22 per ton.

The manufacture of "kuikui" oil, as it is called in Hawaii from the kernels of *Aleurites moluccana* was once an important industry in that country and as much as 10,000 gallons was exported annually to the United States of America. Tung oil has practically taken the place of "kuikui" in that country and although tung oil is much more costly it has better drying properties and is much in demand by the paint trade. There is, however, a big demand for linseed and since candlenut oil is very similar in its properties to linseed and according to American opinion dries four hours sooner than linseed oil and can replace linseed for all purposes for which the latter oil is used it would seem, since this oil has disappeared from the world's markets, that either production costs must be high or else supplies were irregular. It is stated by E. V. Wilcox (*Press Bull.* No. 39, 1913, Hawaii, Agric. Exp. Station) that "kuikui" oil had been on the American market for 75 years and was used in making soap, paint, varnish and artists' oil.

Experiments which have recently been carried out in the chemical laboratory (see Table I) indicate that on the average the percentage of kernel to nut amounts to about 33 per cent. The oil content of the kernels is in the neighbourhood of 60 per cent. so that approximately one third of the nut is kernel and one fifth oil. From these considerations three tons of nuts would produce one ton of kernels and five tons of nuts one ton of oil. Assuming that oil is worth £22 per ton with linseed at £27 per ton, and that £7 per ton of oil will cover the costs of decortication, crushing, oil extraction, and freight, it is apparent that the maximum price that could be paid for kernels would be in the neighbourhood of £10 per ton and nuts about £3 per ton, delivered to the market. Such prices practically exclude nuts from consideration. By the time freight and oil expelling expenses incurred by manufacturers are taken into consideration it is probable that about £5 per ton would represent a gross return for kernels at port of export. Under present conditions in Fiji with high internal freights and hand decortication this price would hardly prove attractive to producers.

As pointed out by the Imperial Institute (*Bull.* 1920 xviii, p. 25.) "the chief difficulty in the exploitation of candlenuts is that of shelling the nuts. The shells are hard whilst the kernels are rather brittle and tend to cling to the shell so that although it is not difficult to crack the shells it is difficult to avoid breaking the kernels into small pieces which often adhere to portions of the broken shells."

From what has been said above it is obvious that for remunerative prices it would be necessary to decorticate the nuts and express the oil locally.

Without pre-treatment the nuts are particularly resistant to mechanical fracture and the kernels adhere firmly to the shell with the result that there is a high percentage of broken and bruised nuts.

In order to cut down the cost of decortication several experiments were carried out on a parcel of 24 lb of old nuts of varying sizes. The total number of nuts was 1,044 of which 94, equivalent to 9.0 per cent. floated on water and were discarded.

The following methods were adopted:—

- (a) crushing without treatment;
- (b) boiling for five hours, standing in cold water overnight and crushing;
- (c) heating in hot-air oven at 140 degrees C. for five hours, standing in cold water over night and crushing;
- (d) heating in steam oven at 100 degrees C. for five hours, standing in cold water over night and crushing;
- (e) Philippine method, burning on open ground with straw, followed by sprinkling with water and crushing.

The following table summarises the information obtained:—

TABLE I.

Process.	(a)	(b)	(c)	(d)	(e)
Weight of nuts	2 lb	2 lb	2 lb	2 lb	2 lb
Number of nuts	87	87	87	87	87
Weight of kernels	9 $\frac{3}{4}$ oz.	11 oz.	10 $\frac{1}{2}$ oz.	11 oz.	10 $\frac{1}{2}$ oz.
Weight of whole kernels	6 oz.	8 oz.	6 $\frac{1}{2}$ oz.	6 $\frac{3}{4}$ oz.	7 $\frac{1}{2}$ oz.
Weight of half kernel	1 $\frac{3}{4}$ oz.	3 oz.	2 oz.	3 oz.	1 $\frac{1}{2}$ oz.
Weight of residue	2 oz.	...	2 oz.	1 $\frac{1}{2}$ oz.	1 $\frac{1}{2}$ oz.
Per cent. of kernel to nut	30.4	34.4	32.8	34.4	32.8
Per cent. whole kernel to total kernel	61.5	72.8	61.8	61.3	71.4
Per cent. half kernel to total kernel	17.9	27.2	14.0	27.2	14.3
Per cent. residue to whole kernel	20.6	...	19.2	11.5	14.3
Total number of whole kernels	26	60	51	51	55
Total number of whole kernels per cent.	19.9	69.2	58.6	58.6	63.5
Time taken to remove shell (minutes)	40	20	20	20	20
Appearance of kernel	white	white	brown badly burnt.	white	slightly burnt.

The samples of two lb lots were shelled by a Fijian assistant in the times stated and it is to be observed that with experiments (a), (c), (d) and (e) the times were shortened by half; nevertheless, 20 minutes is excessive and it is considered that under task conditions this time could be considerably shortened.

The best results were obtained with experiments (b) and (d). Experiment (e) produced slight burning but the yield of whole kernels closely approached (b). The temperature of 140 degrees C. used in experiment (c) was excessive and led to extensive burning of the kernels. The boiling for five hours in water had the added advantage of permitting the clean removal of the kernel from the shell (Experiment (b)) as is shown by the high percentage of whole and half kernels and the absence of residue.

The experiments indicate:—

- (1) the shell can be softened by heat treatment followed by immersion in cold water.
- (2) a temperature of more than 100 degrees C. leads to burning;
- (3) boiling with water (100 degrees C.) permits the easy removal of the kernel from the shell leading to a greater percentage of whole and half nuts and little residue.

Although these experiments indicated that the shell could be softened and the times for decortication reduced by half the actual time taken to decorticate by hand is far too long and the work too tedious for the type of labour available in Fiji unless the work could be organised as a cottage industry.

The Director of Agriculture therefore considered that it might be possible to secure a machine for the decortication and with this object in view several firms were consulted and a small inexpensive hand machine was obtained for the purpose. Several experiments were carried out with this machine on untreated and treated nuts.

From a consideration of the results obtained in experiment (1) the pre-treatment methods were modified somewhat.

The following experiments were performed and the results are recorded in Table II.

- (1) untreated nuts decorticated;
- (2) nuts heated to 200 degrees F. for three hours, cooled for 12 hours at air temperature and decorticated;
- (3) nuts heated to 200 degrees F. for three hours plunged into cold water and decorticated;
- (4) nuts plunged into boiling water kept at boiling temperature for half an hour, then into cold water for two hours and decorticated;
- (5) nuts burnt between straw (Philippine method) sprayed with cold water and decorticated;
- (6) nuts burnt between straw cooled in air and decorticated.

TABLE II.

Experiment number.	1	2	3	4	5	6
Number of nuts taken	400	400	400	400	400	400
Weight of nuts	8 lb 6½ oz	8 lb 10½ oz.	8 lb 13½ oz.	8 lb 5½ oz.	9 lb 9¼ oz.	9 lb 4 oz.
Number of whole kernels obtained ..	47	20	112	116	88	74
Weight of whole kernels	4½ oz.	2½ oz.	11½ oz.	11¼ oz.	10 oz.	8½ oz.
Per cent. whole kernel to nut (weight) ..	3.3	1.8	8.1	8.4	6.5	5.8
Weight of broken kernels free from shell ..	11½ oz.	1 lb 1 oz	1 lb 3 oz.	13½ oz.	1 lb 2¾ oz.	1 lb 5½ oz.
Per cent. broken kernels to nut (weight) ..	8.5	12.3	11.3	10.1	12.0	14.5
Weight of smaller residue free from shell ..	5¼ oz.	10¾ oz.	4 oz.	4 oz.	4¾ oz.	6 oz.
Per cent. smaller residue to nut (weight) ..	4.0	7.8	2.8	3.4	3.0	4.1
Weight of broken kernels with shell ..	1 lb 5 oz.	2¼ oz.	1 lb 1½ oz.	1 lb 3 oz.	1 lb 4½ oz.	13½ oz.
Per cent. broken kernels with shell (weight) ..	15.6	1.6	12.3	11.2	13.4	9.1
Number of whole nuts (unbroken) ..	16	8	4	11	2	1
Time for milling	7 min.	7 mins.	7 mins.	7 mins.	7 mins.	7 mins.

Table (III) details the experimental conclusions derived from Tables (I) and (II). It shows the kernel recovery and the efficiency of the process in terms of total kernel recovery assuming equal machine efficiency. The efficiency of the machine in terms of whole kernel recovery for the pre-treatment considered is also indicated.

TABLE III.

Experiment number.	1	2	3	4	5	6
Per cent. by weight of whole kernel (f.f.s.)	3.3	1.8	8.1	8.4	6.5	5.8
Per cent. by weight of broken kernel (f.f.s.)	8.5	12.3	11.3	10.1	12.0	14.5
Per cent. by weight of residue (f.f.s.)	4.0	7.8	2.8	3.4	3.0	4.1
Total per cent. recovery of kernel material (f.f.s.)—by weight	15.8	21.9	22.2	21.9	21.5	24.4
Expected kernel material recovery (f.f.s.) from Table (I) average.. .. .	32.8	32.8	32.8	32.8	32.8	32.8
Loss of kernel material adhering to shell	17.0	10.9	10.6	10.9	11.3	8.4
Efficiency of process in terms of total kernel material assuming equal machine efficiency	48.1	66.7	67.7	66.7	65.5	74.3
Expected whole kernel recovery for 100 per cent machine efficiency (per cent. by weight), Table I.	30.4	30.4	30.4	30.4	30.4	30.4
Per cent. real whole kernel recovery	3.3	1.8	8.1	8.4	6.5	5.8
Efficiency of machine in terms of whole kernel recovery	10.8	5.9	26.6	27.6	21.3	19.1

(f.f.s.) means free from shell. Percentages are based on whole nut.

The results in Table (III) indicate:—

(i) There is a greater loss of kernel material adhering to shell with the untreated nuts. Making allowances for experimental error similar losses are constant within the neighbourhood of 10 per cent for treated nuts.

(ii) Total kernel recovery is in the neighbourhood of 65 to 74 per cent. with treated nuts and only 48 per cent. with untreated nuts.

(iii) The probable whole kernel recovery with treated nuts is in the neighbourhood of 6 per cent. (excepting exp. 2) and about 3.0 per cent. for untreated nuts.

(iv) That whereas experiment six appears to be more efficient in total kernel recovery experiments three, four and five give a greater all round efficiency in terms of whole kernel recovery and machine efficiency.

(v) The experiments indicate that the type of machine is not particularly efficient.

(vi) The experiments are in close agreement with the findings in Table I, although treatment times have been shortened.

Considering these experiments from the commercial aspect it is probable that with satisfactory methods available for separating kernel material from the meat that a 65 per cent. recovery of kernel material from which the oil could be pressed locally by simple hand presses such as are used in Malaya and the Philippines, might lead to a useful small holders' industry. Whole kernel recovery was low with the machine used nevertheless it would be possible to export at least 6 per cent. of the nut in terms of whole kernel and up to 16 per cent including broken kernels provided the market was not too distant.

It is considered, therefore, that before a possible candle nut oil industry is completely rejected from the scheme of minor industries under consideration by the Department of Agriculture endeavours should be made (1) to effect machine improvement in order to obtain a greater yield of whole kernels, (2) to investigate methods of clean separation of shell from kernel material and (3) oil extraction both with and without decortication.

Work is at present proceeding along these lines.

ENTOMOLOGICAL NOTES.

By

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WORKING in Taveuni, Elijah, Native Field Assistant, reports the presence of larvæ of the mosquito eating mosquito *Megarhines splendens*, in tree holes at Butha Levu. This insect was introduced from Java in 1931.

FRUIT FLY PARASITES.

The recovery, at Nasinu, of the fruit fly parasite *Tetrastichus giffardianus* on the 23rd March last indicated that this introduction had successfully bridged the excessive wet conditions which had prevailed since its liberation in this locality on September 10th of the preceding year.

At Tamavua it was recovered on September 19th having, in this locality bridged the dry period of the previous five months.

Scarcity of wild host fruits renders it impossible to define the present position regarding this introduction, the above records are, however, encouraging.

CLIDEMIA HIRTA (THE CURSE).

After an absence on leave of nine months it is interesting to note the marked further retreat of this pest, which has now completely disappeared from large areas where it was formerly a solid stand, some five or six feet high. Even in the wet Tholo-i-Suva area, the almost pure stand at 8½ miles is now completely gone, fern, mile-a-minute (*Mikania scandens*) and grasses having replaced the weed.

SLUGS.

Whilst the Paris green-bran mixture remains a sound method of dealing with slugs, cutworms and similar pests, seedlings can, in small gardens, be largely protected by placing small pieces of wilting paw paw leaves on the beds. Slugs normally prefer wilting material and will congregate upon this, thus saving the young seedlings, whilst the slugs can be destroyed with a knife by going around once or twice a week with a torch.

A method of controlling cut worms is by the use of Flosol a proprietary article, manufactured by Electrical Chemical Industries Ltd. Filimone, a Native Field Assistant at Navuso, reports that, using this spray on young tobacco seedlings at the rate of four ozs. to eight gallons water and spraying when the plants were dry gave perfect control.

VETERINARY AND ANIMAL HUSBANDRY NOTES.

FOUADIN IN THE TREATMENT OF HEART WORM.

READERS will be interested to know that the outlook in regard to the treatment of dogs affected with *Dirofilaria immitis*, or heart worm as it is more commonly termed, is not now so hopeless as was formerly the case.

A drug which is marketed by various firms under the name of Fouadin or Fuadin is now available for the treatment of this condition. Results of treatment carried out both in Fiji and overseas indicate that the drug is definitely useful.

It is interesting to observe that the drug, which is a complex antimony compound, is named after the late King of Egypt. It was introduced into that country for the treatment of Bilharzia and Kala-azar. It is now extensively used in the southern areas of the United States of America for the treatment of filaria in the dog.

Unfortunately treatment with the drug is not simple. The dose must be accurately computed according to the weight and condition of the dog. It is administered over a considerable period at daily or two-day intervals by injections into muscle, or better still, into a vein.

The treatment is sometimes severe on the dog. The animal loses condition and has rheumatic like pains but these symptoms pass off later as the drug is eliminated from the system.

COCOA.

By

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IN describing the world cocoa situation, the West India Committee Circular of some months ago stated that the present market trend was cheerful, in that consumption in the United Kingdom had increased materially in the last 2½ years. It also added that increased consumption was due to natural causes in that it was to be attributed to the cheapening of the manufactured article and to the general increases in industrial prosperity.

Cocoa prices have continued to show a steady improvement since early in 1935 for most ordinary grades, but for good grades such as Trinidad 1st quality, increases of prices have been substantial.

The present prices (October, 1936) in London for cocoa are approximately as follows:—

Trinidad, fine and superfine	63s.—66s.
Trinidad, fair to good	60s.—63s.
Grenada, good	60s.—63s.
West African, good .. .	41s.—42s.

High grade Samoan cocoa would correspond with similar Trinidad and Grenada grades.

In Trinidad, the chief area from which high class cocoas are derived, the growers are being subsidised to the tune of ½d. per lb which is expected to cost that colony £100,000 per annum in each of the next four years. The condition of estate growers elsewhere is similar and nowhere are profits sufficient to permit of adequate expenditure on cultivation and general attention. The increased consumption and increases in shipments to England are, however, definite signs of improvement.

Production is expected to be fully maintained in the Gold Coast and to increase slightly in Nigeria for several years hence and selection work is likely to lead to increased production in Trinidad, where also efforts are being made to replace cocoa by other crops in such areas as are found to be unsuitable to the crop.

With regard to the possibilities of cocoa in Fiji, the crop has been grown commercially in a few districts but no data are available to indicate whether such ventures have proved profitable.

It has been grown on a very small scale at Nasinu under neglected conditions and produced small quantities of pods at irregular intervals, the fruit being freely attacked by the flying-fox and by rats.

Reports indicate that the Forestero variety and red Java type have been grown but as Criolo is grown in Samoa, no doubt some trees of this variety may also be found.

There would appear to be little chance of cocoa proving remunerative in Fiji under estate conditions on account of high labour wages, but as a small peasant's crop there should be distinct possibilities of it developing into a useful cash crop if good types are grown and if moderate attention is given to the preparation of the commodity.

Climatic conditions (temperatures, rainfall, winds) in Trinidad do not differ materially from those in Fiji and soil conditions in Fiji can be found largely resembling those of Trinidad, in fact many fertile valleys in Fiji,

provided that adequate drainage and wind protection are available, should be capable of producing fair cocoa crops if small growers can be induced to give the trees the necessary attention as regards shade, pruning, cultivation, &c., since the cocoa tree is sensitive to such care.

Young cocoa in Trinidad is given temporary shade by mixed cultivations including yams, maize, bananas, tapioca, pigeonpea, &c., and the same practice is already applied here in developing coconut groves, so that it could readily be applied also to cocoa.

Permanent shade is provided by planting lofty light shade trees at wide intervals through the plantations in Trinidad and Jamaica, and in Fiji there are several trees of a suitable character for the same purpose as well as for "wind breaks," which are essential (a hurricane would be detrimental). At the same time it is doubtful if shade trees would be so necessary here as in Trinidad.

At present, in West Indian colonies, the only post planting cultivation given is a slashing of weeds and undergrowth twice annually which is not a hardship.

Difficulties would arise in the preparation of the crop for market, including the right stage of ripeness for picking, care in picking, handling, sweating, fermenting, drying and curing, but instruction and experience would soon remedy this trouble.

Marketing could be best done by co-operative methods through the Department of Agriculture or by large commercial firms in much the same way as copra is marketed at present, when large crops become available.

Cocoa is subject to several well-known diseases, of which the most likely to affect the crop in Fiji would be Pod Rot, Pod Canker, Dieback, Witch Broom, Thrips and Boring beetles.

It might be mentioned that cocoa exports have now been materially stimulated in Samoa by the improvement in prices and also that, recently, an ungraded sample of cocoa produced in Fiji was valued in London at 45s. per cwt., whilst had it been graded, the high grade portion of the parcel would have been valued at 60s.

It is also worthy of mention that New Zealand in the first nine months of this year imported more than £42,000 worth of raw cocoa, while proportionate amounts are imported into Australia.

In his report on a visit to Samoa in 1933, the Government Entomologist (Mr. Simmonds) reported that yields of cocoa varied between 5 cwt. and 12 cwt. per acre but estimated the average at 600 lb per acre from stands of 200 trees to the acre. This estimate of yield compares favourably with yields in British West Indies and in Ceylon.

There is little doubt that similar results could be achieved in Fiji in small selected areas, such as would be available to peasant farmers and that climatic factors, given moderate protection from winds, would prove suitable for the adoption of this crop by small holders.

Efforts are in progress to collect suitable seed pods for establishment of a cocoa nursery with a view to gaining the interest and co-operation of the native in this potential crop.

SILOS AND ENSILAGE.

By

CHAS. R. TURBET, B.V.Sc., M.R.C.V.S.,
Senior Veterinary Officer.

Owing to the heavy rainfall and high humidity experienced in most of Fiji, haymaking as a means of conserving fodder is not practicable. Most farmers agree that the provision of extra feed, particularly in the winter months, is necessary if the best return is to be obtained from dairy cows.

The problem of supplying this extra feed is a serious one. Although it can be done by the maintenance of crops of para or guinea grass, green maize, or bean for daily cutting, the constantly recurring use of extra labour for this purpose is expensive.

To overcome the problem of provision of supplementary winter feed, the construction of silos and the making of ensilage is urged. A silo in Fiji should be built above ground level to prevent flooding and should be protected by an effective rain-proof roof.

The structure should consist of an upright cylinder with concrete walls. The dimensions may vary to suit the requirements of the owner. An averaged sized silo would be approximately ten feet in diameter by twenty feet in height.

On the side of the silo least exposed to prevailing rain, the continuity of the concrete is interrupted by the insertion of a series of removable wooden doors one above the other, reaching from a few feet above ground level to the top of the silo. The object of these doors is to facilitate the extraction of the feed from the silo.

The filling of silo requires some engineering ingenuity. It is easy enough to fill the lower levels through the doors, but as the height of the column rises, so must greater work be done to raise the feed. In well-equipped establishments, this is done by an endless belt fitted with cleats running between sideboards and over pulleys above and below. The belt runs at an angle of 45 degrees and may be worked by a motor or by hand turning. It is best to chop the fodder before filling the silo. This is done by a chaff-cutter operating at the lower end of the pulley. It can be so constructed that the chaffed fodder falls on to the endless belt.

The silo may also be filled by hand by men walking up a stairway, or enclined plank, or, if the silo is on a hillside, by a bridge from the hillside to silo top.

The fodder materials which may be put into a silo are varied. In Fiji we have a choice of maize, para grass, guinea grass, cane tops, dhal tops, sensitive plant and various beans. Mixtures of these would also be suitable.

The advantage of the silo for Fiji is that the ensilage is protected from adverse weather conditions.

There are no silos in Fiji—as yet, but the time has arrived when they should advantageously be constructed. Perhaps the best argument for their construction is that, generally speaking, the most successful farmers in other countries possess them whilst the less successful do not.

It may be mentioned that guinea grass, sorghum, maize, para grass, &c., which all grow well in Fiji are admirably suited for silo storage and are all capable of producing very heavy crops per acre.

THE TREATMENT OF WOUNDS IN FARM STOCK.

By

ILISONI COKA,
Native Stock Inspector.

VERY often claims have been received from the owners of farm stock owing to injuries to their animals. These injuries may be caused through rough handling or working or in walking in the fields where contact with some sharp object may be the cause of the trouble. The animal should be caught at once and brought into a clean and comfortable place, where the operator can perform his work with no great difficulties, and the wound should be treated antiseptically.

If the accident is recent and the wound clean and aseptic immediate union should be attempted. The suturing thread should be boiled before use as in the case of all instruments used. The maintenance of an aseptic state during the treatment of wounds depends upon using (1) sterile instruments, and dressings, (2) Sterile hands, (3) sterilising the wound, (4) prevention of infection during the period necessary for the healing of the wound.

The possibility of suturing fresh, clean wounds should be considered. If the wound is a contaminated one and does not heal readily the stitch must then be removed and it must be treated as an open wound.

Before performing stitching, the hairs around the edges of the wound should be clipped and thoroughly disinfected. Great care should be taken that no dirt should get into the wound to cause contamination.

The interrupted stitch should be adopted, as it assures a more perfect union of the edges of the skin. If the wound is deep and different kinds of tissues are divided the suture must be made to join similar tissue and as muscle to muscle, &c. In this case catgut must be used.

In commencing stitching an opening should be left unstitched on the top and at the bottom of the wound to ensure the free drainage of any putrid matter from underneath. This is best done by using a rubber tube well inserted into the opening and thoroughly syringed with an antiseptic solution. Eusol is one of the most effective disinfectants for this sort of wound. The preparation is made up of Boracic acid 50 grams. Chloride of lime 50 grams. and water 4000cc. These are mixed and stand for at least twenty-four hours. The clear fluid is then syphoned off and ready to be used. If Eusol cannot be obtained any sort of antiseptic solution could be used, such as weak lysol or salt solution. When the wound is closed it should then be dried off with Methylated Spirit, and then a preparation of antiseptic fly dressing should be coated on to the top of the wound. This preparation should be applied on the wound after each time of dressing.

The wound must then be syringed out three times daily until the healthy granulated tissues are formed and the wound healed underneath and no puss discharging from it.

In about seven or eight days the stitches can be removed and the wound treated antiseptically until it looks dry, when a dry dressing such as dusting powder can be applied to the wound.

Whenever bandgaging is necessary great care should be taken that the bandages are applied evenly and not too tightly, so that their presence may not give rise to an unhealthy condition of the wound from interference with the circulation of the blood.

Punctured wounds of any depth and small openings must not be allowed to close whilst there is the smallest symptom of discharge. Such wounds are healed by granulation and in the first place should be carefully examined for any foreign body.

THE CARE OF DOGS.

By

RARIKUA S. VERA,
Native Stock Inspector.

THE feeding of domesticated dogs has more to do with their health than anything else. Therefore, regular feeding and proper food, including fresh clean water, is required. Most people prefer giving dogs cooked food and of course some foods such as rice, &c., must be cooked. But meat and milk can best be given raw. When feeding dogs with cooked food they will require two feeds daily. With raw food such as meat and milk, one feed daily is quite sufficient for them. Raw food once daily is preferable, giving food such as boiled cabbage and other vegetables once or twice a week.

BATHING.

The best way of bathing dogs is by using warm water and soft soap, washing off all the soap and finally using a weak warm solution of sheep dip. The dog is then dried. In giving the bath it is always better to start from the head because in starting from the middle of the back, fleas run up the head into the ears and around the eyes and hide there. After the bath it is better to take the animal for a walk than to tie it up. Some dog owners use carbolic soap but this is not correct as it irritates the skin and results in scratching which causes inflammation of the skin. Bathing them often is not too good, once or twice a week is quite sufficient.

CARE OF THE SKIN.

It is very important to keep the skin clean and free from fleas and other parasites. Kennels or places where they are kept should be clean and mosquito proof and, finally, daily combing and brushing stimulates and cleanses the skin.

WHY ARE DOGS DETAILED—LENGTH OF TAIL.

Detailing is practised with some breed of dogs. Fox terriers and others are best shown with their tails short. The best time to operate on them is when they are four days or a week old. Although this can be done at any age. In performing the operation on young puppies a pair of scissors and a sharp scalpel are necessary. Clip around the tail at the right length, apply spirit or iodine and tie a tape or string around the base of the tail to prevent bleeding—this may be removed one hour after the operation. The tail is then cut off and bandaged. If the tail is kept clean, free from dirt, no further treatment is required. The length of tail removed on fox terriers should be about two-fifths and spaniels about three-fifths. In removing the tail from older puppies and grown dogs a proper surgical operation with anæsthetic is necessary.

MATING—CARE OF THE BITCH.

Mating is due when the bitch is on heat. Domesticated bitches should be carefully watched when they come on heat. First of all the lips of the valva start to swell up and redness and discharging is seen. The best way to keep the bitch from mating with any other dog, is to lock her up in a room or cage until her time of on-heat is over. Towards the end of this time mating can be done if desirable.

WORMS IN PUPS.

Pups a few days old are known to have worms fully grown in them. Round worms are frequent in pups, such as *Ascarides*. Flat or tapeworms are found mostly in adult dogs. Pups get worms from food and water given to them if they happen to contain the eggs of the worm.

Pups with worms should be treated by giving them a worm mixture in the same amount of milk. It is much better to starve them first—no food at night and give them the dose next morning.

HEART WORM.

Heart worm attacks adults. This worm is long and slender, the male measuring about five or seven inches, the female worm about ten to fourteen inches long. The female worm living in the heart discharges the larvæ into the blood. The larvæ remain in the body for several months and when they are fully grown, start to attack the heart. Spreading or carrying of this worm is done by mosquitoes. At night the mosquito feeds upon an infested dog by drawing the blood containing larvæ of the worm which it goes and distributes to another dog. Short haired dogs are likely to suffer more from attacks of mosquitoes than long haired dogs and therefore also suffer more from heart worm.

To protect dogs from mosquito bites it is best to keep them in mosquito proof kennels at night.

VARIATION IN PASTURES.

By

C. R. TURBET, B.V.Sc., M.R.C.V.S.,
Senior Veterinary Officer.

To a careful observer of pastures it may have been noticed that on land which is subject to fairly continuous grazing or cutting the varieties of grasses and herbage predominant in a field tend to change over a period of years.

There are various causes for this phenomenon such as variation in the amounts and type of plant food in the soil, palatability to stock, nature of growth of the plant, variations in rainfall and temperature changes.

When a plant is newly introduced to an area it may find the various forms of plant food present in the soil in just the correct proportion and amount suited to the peculiar requirements of that particular plant. The result is then that this newly introduced plant grows better than varieties of older established plants in the field. If this new plant is a grass then it is found that the new grass will predominate in the pasture for some time, which may be years. Later on, the soil becomes depleted of the elements most favourable to this particular grass and it is seen that the grass ceases to predominate in the pasture. Another cycle then commences and some other plant begins to predominate.

When pasture land is left ungrazed a particularly palatable grass may be given a chance to dominate the pasture. Subsequently, if stock are allowed to graze the area and the grazing is continued for too long a period the palatable grass may be depleted in the pasture to such an extent that it becomes negligible. The stock in preferring the palatable grass and leaving the less palatable types, allow these latter plants to predominate.

A grass which is much relished by stock and which has an upright or stooling habit of growth is much less likely to dominate the pasture than one which has a spreading growth, throwing down new roots as it spreads. These latter grasses can be grazed much more closely and survive a greater amount of overstocking than the former.

Some plants require conditions having abundance of moisture and as long as rainfall is favourable to them they may predominate in the pasture. When the rainfall is deficient for this particular grass it may either die off or be retarded in its growth to such an extent that other plants or grasses become predominant. The condition of lesser rainfall in this case need not necessarily approach draught conditions.

On the other hand periods of dryness unusual to a country may stimulate the growth of a grass which is normally present but in small quantity.

During the recent period of unusually dry and cool weather grasses of the blue grass family, *Dichanthium*, appeared along roadsides in Suva, practically to the exclusion of other grasses in some areas. The factors of coolness and low rainfall were favourable to it.

The blue grasses are palatable and nutritious grasses and the above observations leads one to anticipate that they would be excellent for winter pasture in the dry zones of Fiji where conditions of coolness and dryness may reasonably be expected annually.

THE CULTURE OF SOYA BEAN.

By

D. N. MALELI,
Native Field Assistant.

A LIGHT loamy soil is best for this crop but it succeeds in poor soil also if other conditions are suitable.

The bean requires thorough soil preparation to provide a good seed bed which should be fairly compact underneath, leaving the surface soil light and loose for two to three inches.

Soya Bean can best be sown between the months of September and February and it takes three to five months to reach maturity. A good way to sow is by hand in drills 30 inches apart allowing six inches between each plant in the rows, ultimately. This requires about 20 lb of seed per acre and the depth of sowing should not exceed two inches.

The seed take three to five days to germinate, unless the weather is very dry. Great care must be taken during the early stage of growth as the young plants will be damaged by birds eating the young shoots, and it is not a bad plan to cover up the rows with dry grass just after sowing for protection from this pest.

As soon as the young plants are through, one good cultivation should be given, and weeds must be kept down until flowering time when cultivation should cease. Hoe in dry weather if possible. The crop is easily ruined in the early stage when growth is slow if weeds are allowed to predominate.

HARVESTING.

When leaves begin to turn yellow, and to fall, the time of harvesting is near. Plants should stand in the field till all leaves have fallen, and when the pods show sign of splitting, the plants should be harvested without delay. Plants should be cut with sickle, and left in small piles to dry in the field, if the weather is fine, turning over the piles if necessary, and if the weather is wet, removed to a dry shed. When the pods are dry and brittle they are threshed. It is very important to see that harvesting should be done during fine weather, but if weather is continuously wet when the plants are ready for harvest, they should be cut and spread in a well-ventilated shed and dried again when favourable weather is available. If harvesting is delayed too long, much of the crop will be lost owing to damage by rain. After threshing the beans should be properly dried, packed loosely in sacks and stored in a ventilated place.

The yield varies from 14—40 bushels per acre according to conditions and is highest when the crop is row planted.

For soil improvement, soya bean can be ploughed in as a green manure if desired. It also affords an excellent fodder for cattle.

GENERAL NOTES.

BROOM MILLET.

BROOM millet which was recently introduced by the Department has been grown satisfactorily in alluvial soils, both in the wet and in the dry zone of Viti Levu. The fibre provides an excellent material for the manufacture of brushes of various kinds as a cottage industry and it is hoped that the cultivation may be extended, particularly through the schools, to form a useful cash occupation for the peasant. Several brushes made locally of this material, locally grown, were exhibited recently at the Agricultural Show and attracted some attention.

SOYA BEAN.

This crop was introduced during the year and on alluvial soil in the wet zone formed a dense cover and produced a good crop of beans in a period of four to five months.

It is hoped that this crop may gradually be extended to Fijians with a view to its use in adding to their diet a most useful food crop, rich in protein, oil and vitamins. It is also of commercial value as it always commands a good market in the United Kingdom either as soya beans or better as soya bean oil, since the cake provides a nutritive cattle food for local use. Furthermore, the cake residues are now largely used, especially in the United States of America, as a basis of plastic materials in motor car construction and in other industries.

TREE PLANTING.

Efforts are being made in co-operation with the Director of Education and the Secretary for Native Affairs to inaugurate an "Arbor" day in Fiji amongst school children. The reported approaching shortage of timbers and, in some areas, of firewood, indicates that a movement such as this may prove useful. The idea being that, on a certain day each year, each school child should plant at least one economic tree in a suitable and protected area adjacent to the school and that such planted trees should be given a little care from time to time. In this way, useful timber reserves can be built up in time, adjacent to each school and the school children may be given some bias towards tree mindedness.

RICE.

Owing to two successive seasons which gave conditions unsuitable for this crop, prices have been exorbitant. Also, imports of rice this year have been very considerably higher than is usual amounting to 1,960 tons valued at £21,500 up to the end of September.

The present season shows signs so far of being favourable to the growth of rice and it is hoped that bumper crops will be harvested. Cultivation in all rice producing areas would appear to indicate a material increase in the area being put under rice this season.

PINEAPPLES.

The Colonial Sugar Refining Company has made good headway with a large area of nurseries and the news of this new large scale venture by the Company is most acceptable as affording an additional means of remunerative employment to many Indians and Fijians in the vicinity of the Company's activities. The excellent quality of Fiji pineapples is well known and this new industry will be a welcome asset to the Colony.

SISAL.

Sisal hemp is to be found in several patches in Fiji and apparently grows robustly under local conditions, but is not now treated for the extraction of fibre anywhere in the Colony. As sisal fibre is now valued at £27 per ton, its extraction should be worth consideration wherever the plant is growing extensively, provided that plenty of fresh water is available. It might be mentioned that Fiji imports annually some £7,000 worth of cordage, rope, &c., which might be produced in the Colony, if labour rates were reasonable. Small holders might also make more use of this plant in providing cordage for their own needs.

VEGETABLE CULTURE.

Householders frequently lament the difficulty of growing good crops of vegetables in this Colony where soils are rapidly leached by frequent and continuous rains but as usual, where there is a will, there is a way. The chief deficiency of garden soils is in humus which retains moisture in the soil and in addition supplies abundance of plant nutrients. Humus can readily be made by collecting all sorts of organic waste, cut grass, weeds, leaves, fruit and potato skins, cabbage stalks, &c., and storing them under moist (not too wet) conditions either in a hole in the ground or in a large pile. To this heap of organic matter some cattle or horse dung, ordinary soil, a little wood ash and a trace of lime should be added roughly in the following proportions:—

Organic waste residues	..	..	..	400 lb
Cattle manure	..	..	..	50 lb
Ordinary soil	..	..	..	60 lb
Woodashes	..	..	..	6 lb
Lime or coral sand	..	..	..	1 lb

The whole mass must be kept moist and turned over about once each month (in moist weather) for three months. Turning distributes moisture in the pile and ensures aeration. After four months the manure thus made should be ready for use and should be fully incorporated in the soil after it has been thoroughly dug to a depth of 18 inches, fully weathered and afforded moderate drainage. Thus, a good soil ameliorant can be very cheaply made and if such piles of manure are maintained in constant succession, they will supply all the needs of most vegetables that can be grown in Fiji. If desirable, of course, additional fertilisers such as sulphate of ammonia and superphosphate can also be added, with benefit but these are best applied as top dressings to the soil after the seedlings have put on a little growth. It is hoped that this note may prove of use in the promotion of vegetable culture.

DWARF COCONUTS.

Recently, Mr. Edward Duncan broadcasted from Suva studio an interesting and instructive discourse of his experience with the Malayan dwarf coconut which dates back to 1921 when he received 800 seednuts mostly of the yellow variety.

He pointed out that the dwarf coconut, owing to its truly dwarf characteristics, as exemplified by its length of leaf, short stature, its early bearing and its small nuts, appeared to be comparatively resistant to damage by storms and hurricanes. For the same reason he mentioned that dwarfs could readily be planted at much closer intervals than the ordinary "talls" so that each acre of land could carry twice as many "dwarfs" as of "talls."

He continued that, although 7,000 "dwarf" nuts were required to produce one ton of copra (as against 6,000 of the ordinary "talls" in Fiji) his experience showed that this figure was well within the capacity of the trees growing under the good conditions of Taveuni.

He added that the Malayan "dwarf" was only suitable for planting under good conditions and near sea level, that it commences to bear at 3-4 years old and at 15 years of age the average length of trunk is about 12 feet. Thus, he pointed out that under good conditions the Malayan dwarf is capable of producing twice or even three times as much copra as the ordinary "tall" palms as grown in Fiji and which average about 7 cwt. of copra per acre.

It is of interest to note that in a recent number of the *Malayan Agricultural Journal* (September, 1936) yields 31 cwt., 29 cwt. and 34 cwt. of copra per acre are recorded from large blocks of dwarf coconuts for the years 1933, 1934 and 1935 respectively on one well known estate in Malaya, which estimated a crop of 35 cwt. for 1936. The dwarf area of this estate was planted in 1920 and since 1928 the copra yields exceeded 19 cwt. per acre per annum.

It may be mentioned that this Department of Agriculture has a small plantation of "dwarfs" in bearing on which selection experiments are in operation.

FORESTS.

It may be of interest to state that the following "talk" on Forests, prepared by Dr. H. W. Jack (Conservator of Forests) was recently broadcasted to Fijians in their own language by courtesy of the Suva Studio.

The forests in Fiji are the source of many of the necessities which are readily available to the independent peasant and the town dweller.

Thus, the forests provide a large reserve of good fertile soil in which food crops are grown; they provide the materials utilised in the building of houses and in the making of furniture; they supply the logs required for the erection of bridges and fences, and the manufacture of export fruit cases. They supply wood fuel for warmth and cooking. The trees yield materials which are converted to clothing, which supply lighting, medicines, cordage, weapons, rafts, boats, edible fruits, and enormous ~~other products~~ ^{market goods} which play a part in the daily life of the Fijian. The forests also shelter pigs, game birds, and fish and provide reservoirs of clean water from which streams and rivers arise to supply drinking and washing water, and ready means of transport. Thus, to the Fijian the forest is a never failing source of supply of the indispensable materials of life and hence, its immense utility must be readily realised if he gives any thought to the matter.

Unfortunately as civilisation advances, large tracts of forests are felled to provide land suitable for agricultural development, to provide access roads and grazing grounds and care should be taken so that such areas are adequately protected against soil erosion—the loss of the fertile top soil, as well as subsoil, by heavy rains and exposure to wind and sun. In such areas also, the lack of the more valuable and commonly used timber trees is soon felt and the effects of the practice of shifting cultivations in the reduction of soil fertility is early apparent.

It is also well known that forests play an important part in affecting climate, especially the rainfall, which may be materially altered not only in amount but in incidence by their destruction, and the effect of such climatic changes on agricultural operations is obvious.

The forests on mountain slopes are of particular value in that the foliage of the trees protects the ground from the mechanical disintegrating effect of heavy rains, and the forest soil below, being rich in vegetable matter, acts as a sponge and absorbs the water gradually and gradually releases it.

Where the hills are well covered by forests, the heavy rains are absorbed and the danger of floods is greatly reduced, so that a heavy downpour of rain produces a slight rise in the level of the rivers; while in times of drought river levels will fall slowly, gradually drawing on the reserves of water held in the spongy soil of the forests.

In comparison, where the hills are denuded of forest, every rain storm will give rise to innumerable torrents which sweep away good fertile soil, often laying bare the underlying rocks; the rivers will flood and damage crops and property and will quickly subside, because they have no reserves of water on which to draw; while in times of drought the rivers will dwindle to a mere trickle, which may even prove insufficient for the needs of the people living in its vicinity.

The forests of Fiji are quite equal, under scientific management, to the task of supplying indefinitely all possible future requirements and even of providing a balance of our better class woods for export, whereas the average imports of timber amount to about £19,000 each year at present, and much of our forest is uneconomic to work but improvement in this direction would not be difficult.

This brief note is intended to indicate the very great value of the forests to the inhabitants of the country and their general indispensability in the economics of the people. Therefore, it is hoped that the value of the forests will be realised and that they may be accorded good treatment in order that their value may be fully maintained and improved.

AGRICULTURAL SHOW.

The Department of Agriculture as is usual, put up a comprehensive exhibit at the Show which was held in Suva on 19th October, to illustrate the lines along which work was being done. The chief feature of the exhibit was a standardised small copra drier which attracted much attention as did the very fine samples of copra made by Fijians using the new driers. Other exhibits included tobacco and a tobacco spinning machine, cotton, broom millet (and brushes made from it) vegetables (24 kinds) condiments, areca-nuts, rice, maize, soya bean, dhal, gram, fruits (15 kinds), cocoa, tea, coffee, sisal, kapok, sann hemp, cover crops, arrowroot, ginger, economic timber and fruit trees and some 40 ornamental flowering and foliage trees and shrubs.

Poultry husbandry was represented by the display of a type of fowl house and run containing pure bred poultry which is recommended for local conditions and which attracted considerable notice. The progress of the dairy industry in Fiji was portrayed in two instructive graphs while a model pigsty and types of pig and cattle feeding utensils served as useful demonstrations.

Some giant toads, hawksbill turtles and cases of economic insects proved a constant centre of interest and there was a comprehensive display of local fodder grasses under glass, and of pathological specimens.

An interesting display of sugar cane varieties, standardised cultural methods, pests and samples of various grades of sugar was put up by the Colonial Sugar Refining Company and proved very attractive.

In the native competitive section which was organised by the Department of Agriculture the most prominent feature was the display of excellent copra put up by "exempt" Fijians using the new type of Kiln which is now fast coming into use by progressive Fijians. There was also a good display of native foodstuffs and two attractive district exhibits. Indians for the first time, figured as exhibitors and put up a few comprehensive but small exhibits.

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